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Aviation Week and Space Technology

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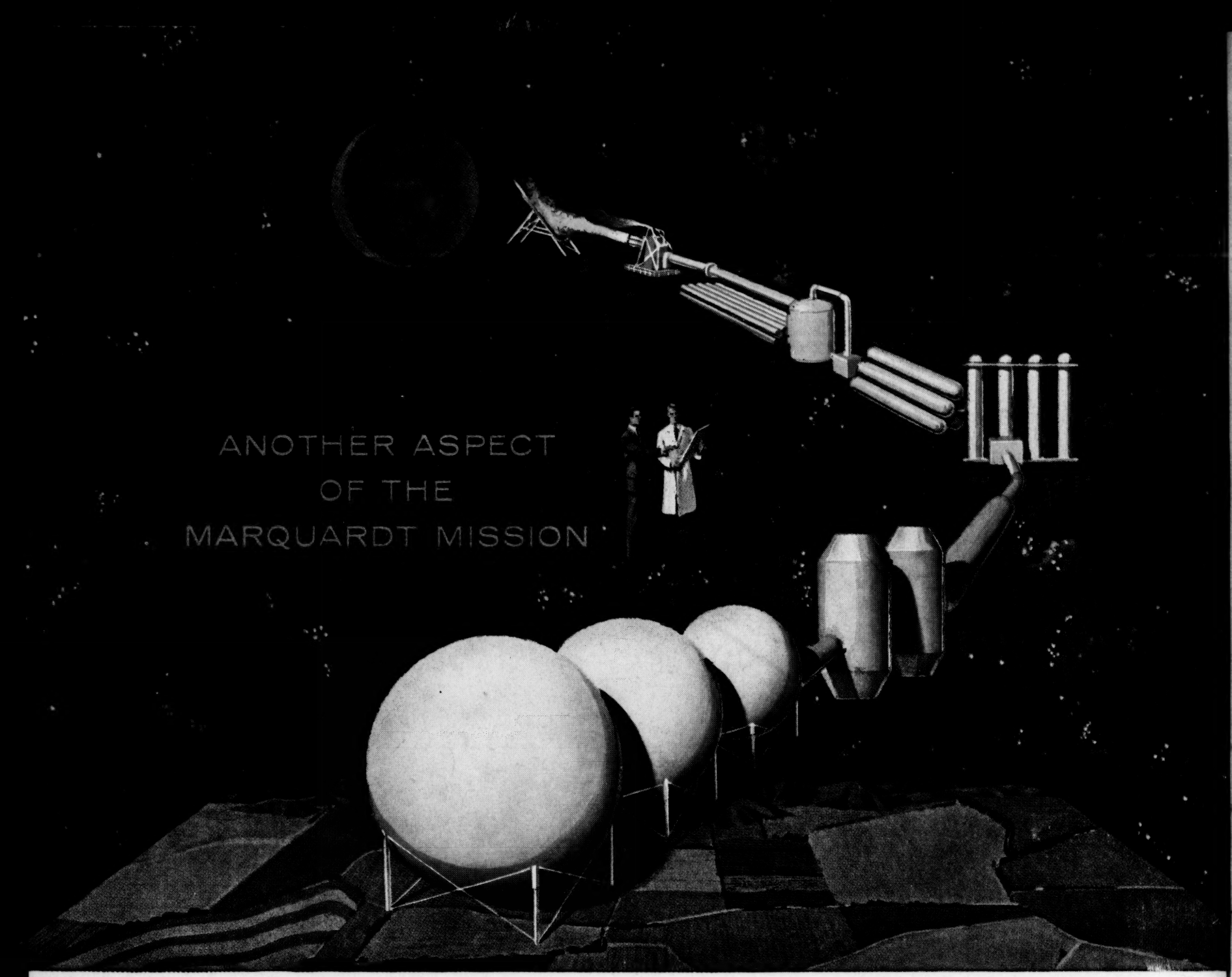

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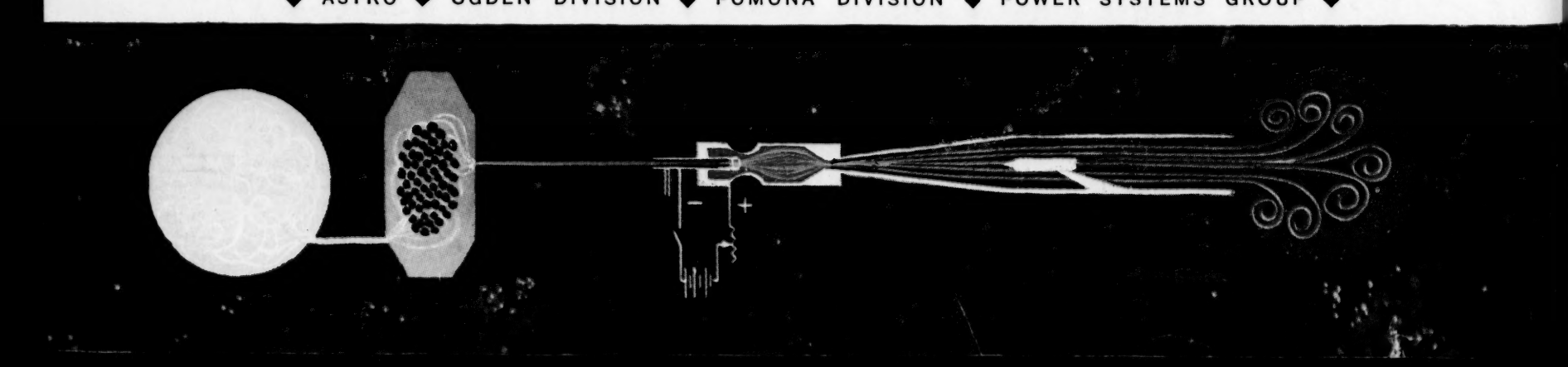

AVIATION CALENDAR

May 8-10—Spring Lubrication Symposium, American Society of Mechanical Engineers, Deauville Hotel, Miami Beach.

May 8-10—National Aerospace Electronics Conference, IRE, Miami and Biltmore Hotels, Dayton, Ohio.

May 8-12—Annual Meeting, Airport Operators Council, Carillon Hotel, Miami Beach, Fla. (AOC-American Society of Civil Engineers' Joint Seminar, "Increased Capacity of Airport Systems," May 11-12.)

May 9-11—Western Joint Computer Conference and Exhibit, Ambassador Hotel, Los Angeles, Calif.

May 10-12—Spring Meeting, Society for Experimental Stress Analysis, Benjamin Franklin Hotel, Philadelphia, Pa.

May 11—Air Force Office of Scientific Research Lecture and Banquet in honor of the 80th Anniversary of Theodore von Karman, Sheraton Park Hotel, Washington, D. C.

May 12—National Armed Forces Day Dinner, Sheraton Park Hotel, Washington.

May 12-14—Mid-America Air Fair, Municipal Airport, Wichita, Kan.

May 15-16—Region One Air Traffic Control Assn. Convention, Hotel Bradford, Boston, Mass.

May 15-16—Aviation Fire Safety Seminar and Technical Session, National Fire Protection Assn., Hilton Statler Hotel, Detroit, Mich.

May 15-17—National Symposium on Microwave Theory and Techniques, IRE, Sheraton Park Hotel, Washington, D. C.

May 15-18—20th Annual National Conference, Society of Aeronautical Weight En-

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AVIATION WEEK and Space Technology

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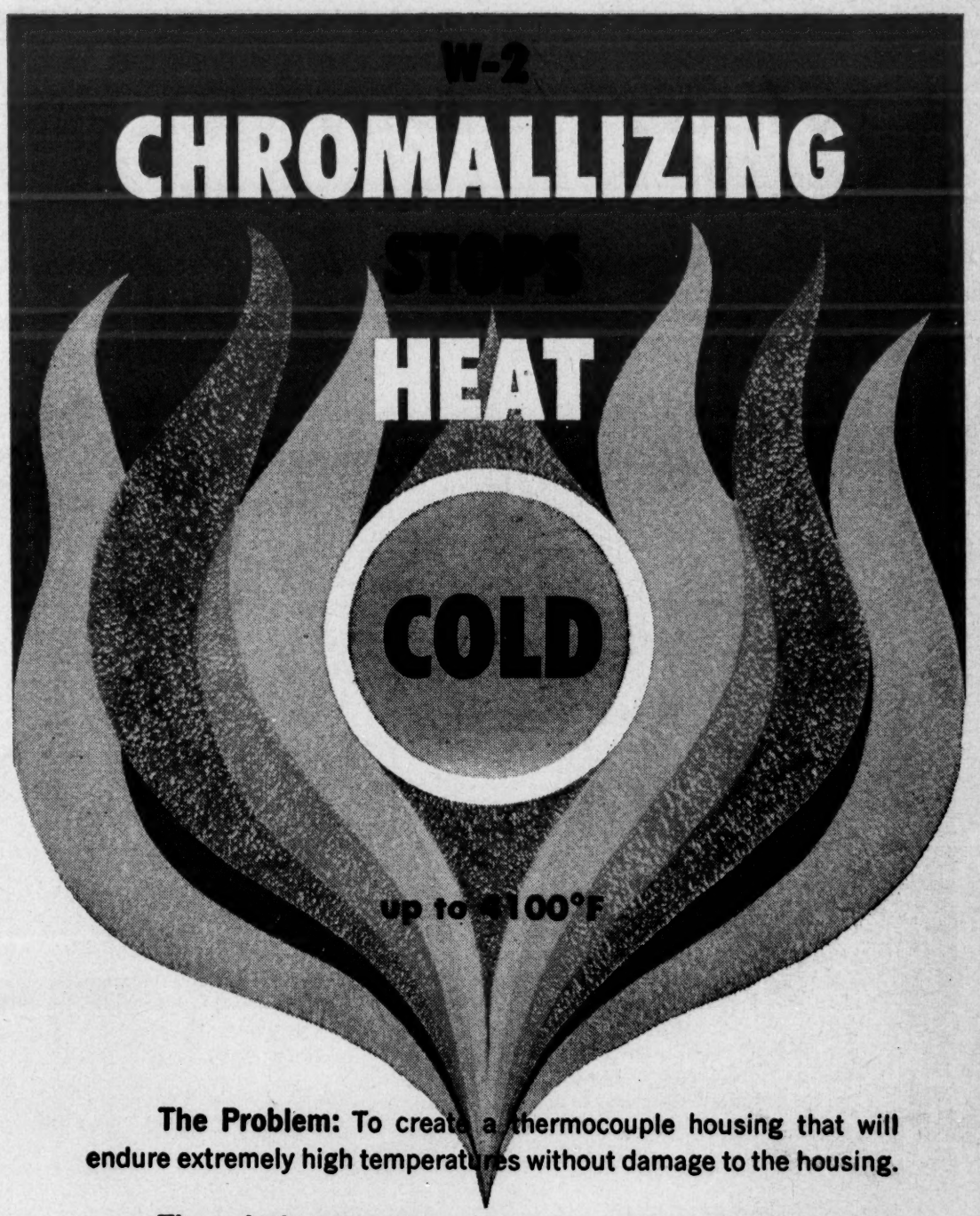

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AVIATION CALENDAR

(*Continued from page 5*)

gineers, Sheraton Hotel, Akron, Ohio.

May 22-24—National Telemetering Conference, Sheraton-Towers Hotel, Chicago, Ill.

May 22-24—Fifth National Symposium on Global Communications, Institute of Radio Engineers, Hotel Sherman, Chicago.

May 23-25—Quarterly Conference, Society of Automotive Engineers' Military Ground Support Equipment Committee, Continental Hilton Hotel, Mexico City.

May 23-27—Navy League Convention and Air-Seapower Symposium, Washington.

May 26-27—First National Conference on the Peaceful Uses of Space, Tulsa, Okla. Sponsors: NASA; Tulsa Chamber of Commerce.

May 26-June 4—24th French International Air Show, Le Bourget, Paris, France.

May 27-30—13th Annual Wright Memorial Glider Meet, Soaring Society of Dayton, Dayton, Ohio.

May 31-June 2—University of Michigan's Seventh Annual Radar Symposium, Ann Arbor, Mich.

June 2-3—12th National Maintenance and Operations Meeting, Reading Aviation Service, Inc., Reading, Pa.

June 13-15—National Joint Meeting, Institute of the Aerospace Sciences and American Rocket Society, Ambassador Hotel, Los Angeles, Calif.

June 13-15—37th Meeting, Aviation Distributors and Manufacturers Assn., Dennis Hotel, Atlantic City, N. J.

June 14-15—Fifth Annual Conference, Product Engineering and Production, Institute of Radio Engineers, Sheraton Hotel, Philadelphia, Pa.

June 19-21—Space Flight and Re-entry Trajectories Symposium, International Astronautical Federation's International Academy of Astronautics, Paris, France.

June 22-23—Eighth Annual Symposium on Computers and Data Processing, Denver Research Institute, Elkhorn Lodge, Estes Park, Colo.

June 26-28—Fifth National Convention on Military Electronics, Institute of Radio Engineers, Shoreham Hotel, Washington.

June 26-30—Special Technical Conference, American Institute of Electrical Engineers' Aerospace Transportation Committee, Benjamin Franklin Hotel, Philadelphia.

June 28-30—Joint Automatic Control Conference, University of Colorado, Boulder, Colo.

June 28-July 1—Annual Meeting, Institute of Navigation, Williamsburg Inn, Williamsburg, Va.

July 25-Aug. 10—International Trade Fair and Aviation Exhibition, McCormick Place Exposition Center, Chicago, Ill.

Aug. 22-25—Western Electronic Show and Convention, Cow Palace, San Francisco.

Sept. 4-10—1961 Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

Sept. 6-8—National Symposium on Space Electronics and Telemetry, Institute of Radio Engineers, University of New Mexico, Albuquerque, N. M.

Sept. 10-12—National Convention, National Aeronautic Assn., Westbury, N. Y.

Oct. 2-7—12th International Astronautical Congress, Washington, D. C.

May 1, 1961

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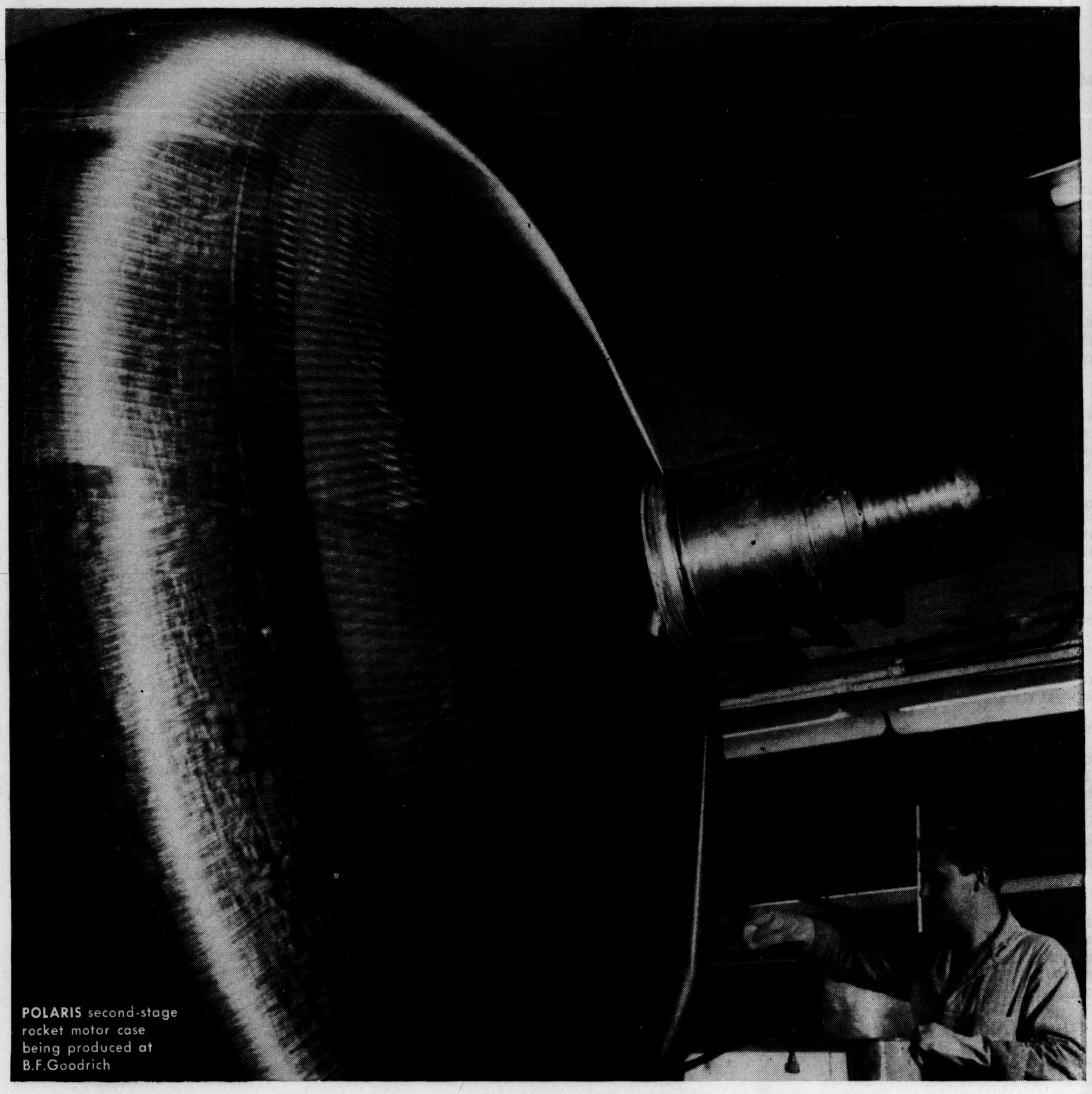

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EDITORIAL

Airlines in Transition

It has become painfully obvious as the airlines speed onward through the jet age that their most important problem lies in profitably utilizing the vast new seat capacity that the size and the speed of the jet airliner has created.

Thus, it is encouraging to note new signs of activity in many sectors aimed at basic broadening of the airline market and at providing large segments of the now non-flying population of the world with new and compelling reasons to buy airline tickets. The 17-day transatlantic excursion fares, Eastern's air bus service experiments, and the off-season, low fare Florida package promotions of Eastern, National and Northeast all are hopeful straws in the economic wind. For it should also be obvious by now that the airlines will not solve their jet capacity and profit problems by simply competing with each other for a larger share of the current market. Only by basically broadening the scope of markets they can tap successfully will this problem be truly solved.

There has been a good deal of public discussion regarding the Civil Aeronautics Board's contribution to the problems facing the airlines, and this contribution has been substantial. It is evident now in retrospect that what was a basically sound policy of introducing more competition, particularly on virtual monopoly routes, has been carried too far, and that with the advent of large capacity jets, it has created far more competition than is economically supportable or perhaps necessary for genuine public convenience.

It is difficult to follow the CAB logic of recent years that on one hand created a giant airline octopus in the United-Capital merger and on the other has stubbornly persisted in trying to turn Eastern Air Lines from one of the Big Four carriers into a regional operation. The technical and economic impact of the jet age apparently has not yet penetrated as far as the CAB and its staff if recent decisions are any indication.

The whole pattern of air transport, domestic and international, requires a basic new appraisal in light of the technical capability and economic problems posed by jet equipment if the world's airlines are to develop the full potential of this tremendous new contribution in time to retain their financial health and growth vitality.

There are still technical bottlenecks as well as economic problems facing any attempts to extend the air travel market in significant scope. The pressure of current traffic volume has the air traffic control system bursting at the seams. It is now imposing an artificial limit on airline operational capacity as well as introducing a factor of schedule irregularity that cannot help but be discouraging to potential air travelers.

It is perfectly sound to try to plan properly for the air traffic environment of a decade hence. But there is also an acute problem of how to utilize fully the equipment already installed on the airways and in aircraft and control centers. There has been far too much emphasis on long range planning—always a favorite government game—and not enough push toward more effective and realistic use of the navigation and landing aids already available.

This is an area where the new Federal Aviation Agency chief N. E. Halaby could apply his talents to good purpose for the immediate future as well as for the "ultimate system"—which always appears to be on the technical horizon but which manages to keep receding with each passing year.

Along with the new attacks on broadening the airline market, we have noticed an increased attention by the airlines to the needs and problems of its current passengers. Passenger service took a bad beating in the mushroom post-war growth of airline traffic, producing in recent years an almost mutinous state of mind in the seasoned air traveler. The pendulum has begun to swing back, however, and it is heartening to find in almost every aspect of the passenger's contact with his carrier that much more effort is being devoted to easing his lot.

Even when the airlines are confronted with the inevitably insoluble passenger problems imposed by weather and other acts of God, they are once again giving their passengers the impression they really care and the "tough luck, Buster" attitude is again fortunately on the wane. Among specific improvements are the increasing number of new terminals where baggage handling almost matches the passenger's pace in leaving an aircraft and the many places where it is now possible to board in bad weather without being drenched or frozen.

The local service airlines are continuing to grow at a vigorous pace, topping the billion passenger mile mark for the second straight year in 1960 in addition to recording substantial increases in mail and freight tonnage. With the class mail rate and more accurate accounting systems, it should be possible to separate the local service carriers' real subsidy needs and permit their expansion into profitable non-subsidy routes that will not fit the trunk carriers' equipment in the jet age.

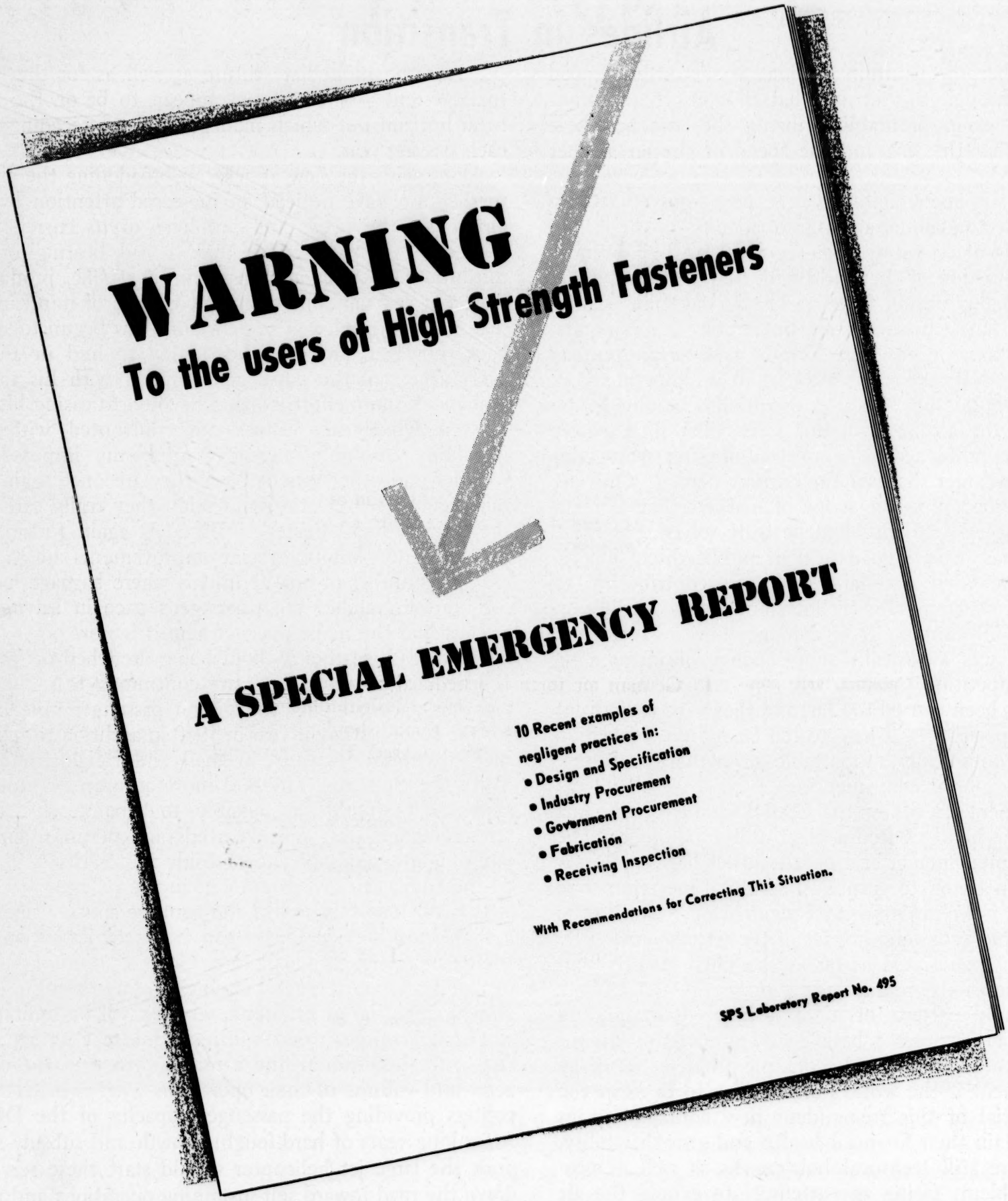
It is obvious that unless the genuine subsidy need of certain local service routes can be precipitated out of their general operating picture, Congress cannot be expected to support ever-increasing subsidy, and the real growth potential of profitable services will be limited.

The helicopter carriers will jump into the jet age this year, and they should find a major change in the character and volume of their operations with twin jet helicopters providing the passenger capacity of the DC-3. After long years of hard-fought growth and subsidy support, the large jet helicopter should start these services down the road toward self-sustaining operations and provide the impetus for a major expansion of helicopter service patterns in many large urban areas.

While the airlines are struggling hard to keep their financial heads above water, they face increasing efforts by government at all levels from the federal government to municipalities to push them under with increasing taxes and higher landing fees. This factor alone could negate any real economic progress the airlines may make during the next year.

This will be another tough year for airlines both economically and operationally, although traffic in all categories will reach new peaks. But hopefully, by the year's end many of the seeds of future economic growth will have sprouted and will be clearly visible above the welter of problems that arrived inevitably with the jet age.

—Robert Hotz



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Charles S. Payson, board chairman of Vitro Corp. of America, New York, succeeding **J. Carlton Ward, Jr.**, resigned.

William E. Kidd, Maurice Goodman and **Page Hufty**, directors of Aircraft Armaments, Inc., Cockeysville, Md. Mr. Kidd is an investment broker; Messrs. Goodman and Hufty are directors of United Industrial Corp., parent organization of AAI.

R. T. Orth, a director, Eitel-McCullough, Inc., San Carlos, Calif. Mr. Orth is the company's vice president-operations.

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Dr. Wolfgang W. Gaertner, vice president in charge of solid state physics, CBS Laboratories, Stamford, Conn.

H. Don Reynolds, Traffic Director of International Air Transport Assn., Montreal, Canada.

Maj. Gen. Sory Smith, chief of staff, Tactical Air Command. **Brig. Gen. G. S. Cassady** replaces Gen. Smith as commander, 6th Air Force Reserve Region, Continental Air Command.

Maj. Gen. G. W. Martin, military assistant to the Secretary of the Air Force. **Maj. Gen. D. A. Burchinal** replaces Gen. Martin as director of plans, DCS/Plans & Programs, USAF Headquarters.

Maj. Gen. E. Moore, acting vice commander, Air Defense Command.

Honors and Elections

Thomas W. Finch, X-15 project manager at the National Aeronautics and Space Administration's Flight Research Center, has been awarded a one-year Sloan Fellowship at Massachusetts Institute of Technology. **James E. Love** replaces Mr. Finch as project manager for the X-15.

Henry I. McGee has been elected president of the National Aeronautical Services Assn. Other officers: **Mrs. Isabel McKay**, vice president; **Harry S. Baer, Jr.**, secretary-treasurer. Mr. McGee is president of Dallas Airmotive, Inc.; Mrs. McKay is president of Embry-Riddle Aeronautical Institute; Mr. Baer has been with the association since 1955.

President Kennedy has appointed **Francis T. Fox** a member of "Project Horizon," a special task force formed to study national aviation problems and recommend goals to be achieved in the period 1961-1970. Mr. Fox is general manager of the Los Angeles Department of Airports.

(*Continued on page 130*)

INDUSTRY OBSERVER

► Portions of North American Aviation and Hughes Aircraft team proposals in the Project Bambi competition will be funded, although neither team was chosen to conduct a complete study—largely because of Air Force-Advanced Research Projects Agency differences over which had the better approach. Hughes, for example, was told it was selected as sole source to work on the interceptor vehicle associated with each Bambi satellite. This would include guidance, target seeker, propulsion and warhead.

► Air Force has narrowed the competition for a contractor to outfit two ships as Mobile Atlantic Range Stations (MARS) to four teams, headed by General Dynamics/Electronics, Lockheed, Raytheon and Sperry Rand.

► NASA's Jet Propulsion Laboratory will select one company from the four now completing feasibility studies of 200-250 ft. tracking antennas (AW Jan. 16, p. 99) to conduct a detailed design study. Later, a competition will be held for the multi-million dollar job of constructing the antennas, which are expected to significantly increase capacity to communicate with deep space probes.

► Contractor to engineer and build an S-band (2,295 mc.) instrumentation receiver and a low-level transmitter (2,115 mc.) will be chosen by NASA's Jet Propulsion Laboratory this week as JPL moves to convert its deep space instrumentation facility from lower UHF frequencies to S-band. Bidders include Hoffman Electronics, Space Electronics Corp., Alpha-Collins, General Instruments, Hallamore Electronics, Hughes Aircraft and Gilfillan Bros.

► First of 96 U.S.-produced Lockheed F-104Gs ordered by the West German air force is scheduled to arrive in Germany by air transport this month. First German F-104G fighter-bomber unit, Wing 31 stationed at Norvenich air base near Bonn, should be operational by the end of the year. Initial European-produced F-104 airframe is scheduled for final assembly next fall.

► Army's Project Advent communications satellite will carry a proton spectrometer to produce data indicating any damage that might result from proton impact on Advent and subsequent payloads.

► Northrop T-38 supersonic trainer is being evaluated now by German air force technicians in both the U. S. and Germany. Jet trainer competition now appears confined to the T-38 and a two-seat version of the subsonic Fiat G.91.

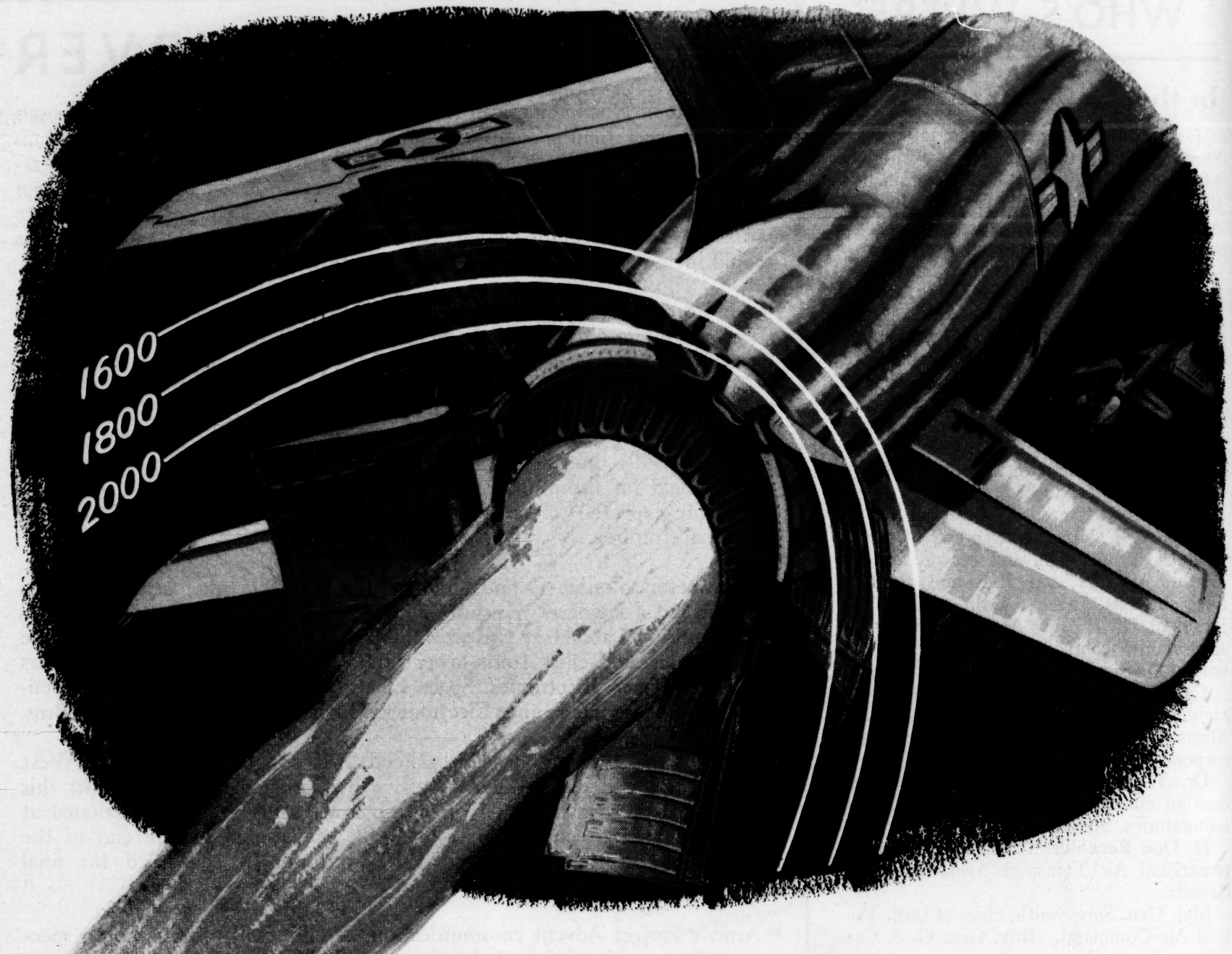
► Douglas El Segundo Division is conducting a study on variable sweep wings for the Navy which is expected to have application to light attack aircraft under consideration for future development. Douglas also is studying capsule-cockpits for use with attack-type aircraft.

► Air Force and Advanced Research Projects Agency are becoming increasingly interested in applying optical masers to such key areas as secure communications, ranging, guidance and possibly even radiation weapons. Latest in a growing series of proposal requests from military services (AW Apr. 24, p. 81) is one for an experimental optical maser now on bid from USAF's Space Defense Systems Laboratory at Rome Air Development Center.

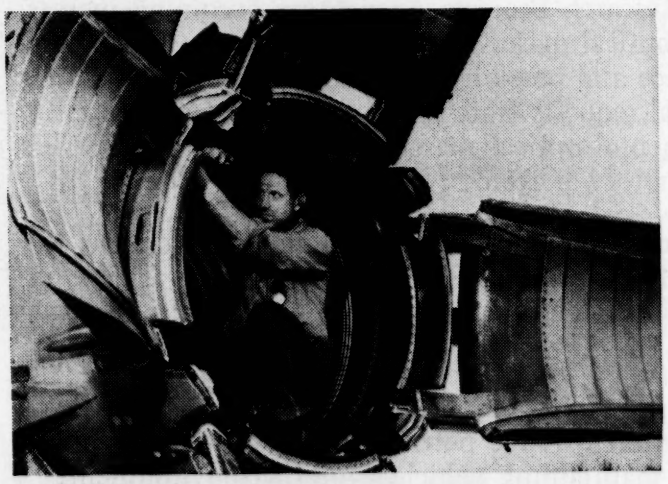
► Defense Department has not yet approved a funding extension for the advanced biomedical capsule Lockheed Missile and Space Division is developing for a 50-lb. chimpanzee during a 48-hr. orbit (AW Dec. 12, p. 28).

► Thermal and atmospheric systems for space vehicles are being studied in a three-year program at North American Aviation under a USAF Aeronautical Systems Division contract. Large portion of the work is concerned with systems integration for maintaining vehicle's internal environment.

► USAF may use a recorded woman's voice to warn B-58 pilots of emergencies. When an emergency warning light is triggered, the recording would give audio warning and recite the appropriate check list. Woman's voice would be used to introduce an unusual sound to attract pilot attention.



Braking 23 Tons at 1200 MPH



Mechanic adjusts hinge of speed-brake door whose critical parts are of HAYNES alloy No. R-41.

Few brakes are called upon to take such a beating. That's why HAYNES alloy No. R-41 was selected for all critical areas of the petal-type speed-brake on the Air Force's new F-105 Thunderchief fighter-bomber.

Closed, the tail-mounted "petals" encircle the flaming gas blast behind the J75 engine's afterburner. Then, tremendous stress loads and thermal shock are imposed as the searing-hot doors whip open into the cold airstream—to check the blazing speed of the 23-ton, Mach 2 fighter.

HAYNES high-temperature alloys that resist temperatures of 1700 deg. F and over—for long periods and under great stress—today serve many hot spots. Resistance to stress, to thermal shock, to corrosion, erosion, and fatigue, are typical properties that make these alloys so extremely useful in turbojet engines, in ramjets, missiles, rockets, manned space capsules.

Whether investment- or sand-cast, rolled, wrought, vacuum melted, or air melted, there's a HAYNES high-temperature alloy to meet your needs.

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Washington Roundup

Key Space Meeting

Critical meeting on the U.S. space program was to take place May 1 at the White House, with chairmen of the Senate and House space committees, the Vice President, the head of the civilian space agency, the executive secretary of the space council and the President's science adviser meeting with President Kennedy. House committee has held off final action on the space agency's authorization bill for the Fiscal 1962 budget, indicating that more changes can be expected.

National Aeronautics and Space Council apparently is taking a dual approach in responding to President Kennedy's instruction to find ways of excelling Russia in space exploration (see p. 29). In addition to its search for ways to increase the solid U.S. lead in such areas as weather observation and communications, it is frankly seeking space "spectaculars"—something the previous Administration abhored in its public attitude and something President Kennedy initially showed a coolness toward.

Signing legislation that makes Vice President Lyndon Johnson head of the council, the President last week left no doubt that he believes a contest exists. He called the law "a key step toward moving the U.S. into its proper place in the space race." The term "space race" has provoked more argument since October, 1957 than almost any other single aspect of the space effort.

Survey of the nation's progress on military and commercial communications satellites has been completed by the Office of Defense Research and Engineering at the request of Defense Secretary Robert McNamara. It is understood to confirm AVIATION WEEK's report (AW Apr. 17, p. 104) that the lack of a clear-cut national policy and a single inter-agency focal point of authority is delaying development of a commercial satellite system, which the Defense Department needs for overseas communications.

Meanwhile, the House space committee has postponed its hearings on commercial communications satellite policies and progress at least until next week. Federal Communications Commission has asked for a still further postponement until it receives industry comments on its recent inquiry (AW Apr. 10, p. 34), but the committee is not expected to grant this request.

Rover in Limelight

Rover nuclear rocket program is the object of more attention than it has had since its initiation. In spite of dire predictions from some congressmen that current reviews may be aimed at killing the project, statements by President Kennedy and speculation surrounding the activities of various technical and politico-technical reviewing groups seem to indicate that Rover will be accelerated.

Space task group headed by Presidential Science Adviser Jerome B. Wiesner sounded a hopeful but very cautious note about Rover's promise three months ago. A group appointed by Wiesner now is looking over the entire project. So is the National Aeronautics and Space Council, but it probably will base any recommendation it makes on the Wiesner group's findings. National Aeronautics and Space Administration's technical people also are making their own survey.

The House space committee will report this week on its Rover hearings as well as on its inquiry into the Defense Department directive giving Air Force most of the responsibility for space payload development. Chairman Overton Brooks gave a preview of the Rover findings last week when he called on the Administration to give nuclear rocket development top national priority along with the Saturn booster and the Mercury manned space flight program. He said he based his conclusion on the hearings and a staff investigation.

Protest Lacking

Congressional silence on the Kennedy Administration's move to give KLM, the Dutch airline, a route into Los Angeles is causing concern in the airline industry. Congress generally has sided with the airlines in what the carriers call the "U.S. give-away policy" in granting routes to foreign carriers. Air Transport Assn. President Stuart Tipton says one of the carriers' major problems is that "the opposition of the American public and Congress" to give-aways "is not expressed adequately."

USAF Chief of Staff Gen. Thomas D. White says Army will be given the deciding role in selection of an aircraft for immediate build-up of USAF's close-support capabilities. Army is believed to favor the Navy-Douglas A4D.

Gen. White and Army Chief of Staff George H. Decker have agreed on a proposal to retain tactical air units now earmarked for deletion and to equip them with an aircraft of the Army's choice. A joint study of the proposal is now under way.

President Kennedy last week proposed six executive actions and an Executive Employee's Standards Act aimed at streamlining conflict of interest statutes and regulations. He called for "unwavering integrity, absolute impartiality and complete devotion to the public interest" from public officials.

—Washington Staff

Traffic Trends Threaten Airline Profits

Business resumes growth in March, but 1961 deficit may result from first quarter slump, coach gains.

By L. L. Doty

Washington—First quarter traffic slump, coupled with sharp declines in high-revenue-yield first class business, now suggests that the trunkline industry may be headed for a deficit this year.

Although traffic volume resumed its upward trend in March, following a four-month period of steady declines, most industry officials are looking at the immediate future cautiously and with a trace of pessimism, particularly in view of the revamped route structure under which the industry will operate beginning in mid-June (AW Apr. 17, p. 40).

Chief cause for concern is continuing evidence that the expanding popularity of coach travel is merely draining first class traffic without creating new markets (see p. 38). Big question is what effects the Capital-United merger, to be effective June 1, and the new transcontinental services by Delta and National, to be effective June 11, will have upon the redistribution of traffic among individual carriers.

It is now generally conceded by the Civil Aeronautics Board that these route adjustments will be watched closely and that further realignments will be made if the industry is thrown into a dangerous imbalance with respect to each carrier's share of traffic.

Individual Progress

Thus, a proper evaluation of the trunkline industry cannot fairly be based on an analysis of the industry as a whole, but it must explore the relative competitive progress of each carrier thus far this year. Because the flight engineers' walkout against six trunklines in February distorted normal traffic distribution, traffic figures for that month cannot properly be used to determine individual carrier trends.

The aftermath of the walkout continued into the first days of March, but generally, traffic activities returned to a normal level sufficiently early to use that month as some measure of the competitive success of each carrier. Specifically, traffic statistics for the month point up the comparative growth of individual coach services within the industry.

During March, the 12 trunklines reported a 3.9% increase in revenue passenger miles over the same month last year. Coach service accounted for 52.9% of total traffic, compared with 44.7% in March, 1960. Data available from 10 of the trunklines shows a 6.3% decrease in first class traffic, a 32.8% increase in coach traffic.

United, once a vigorous opponent of high density coach seating, became the largest domestic carrier of coach traffic in March, moving from the third place position it held in the same month last year. The airline reported a 66% increase in coach traffic, compared with a 28% gain for American, 25% for Eastern and 18% for TWA. United was a leader in the successful drive to increase coach fares last year.

United Leads Industry

United was second to American in the volume of first class revenue passenger miles generated during the month, but it led the entire domestic industry in total revenue passenger miles handled. United moved 37% ahead of the volume carried in March, 1960, while American's volume rose only 0.7%, Eastern 1% and TWA 3%.

Impact of United's jet fleet on its capacity is reflected in the 57% increase in coach available seat miles and the 14% increase in first class available seat miles. American, Eastern and TWA, presumably guided by the trend toward coach, cut first class available seat miles in March by 13%, 21%, and 11% respectively.

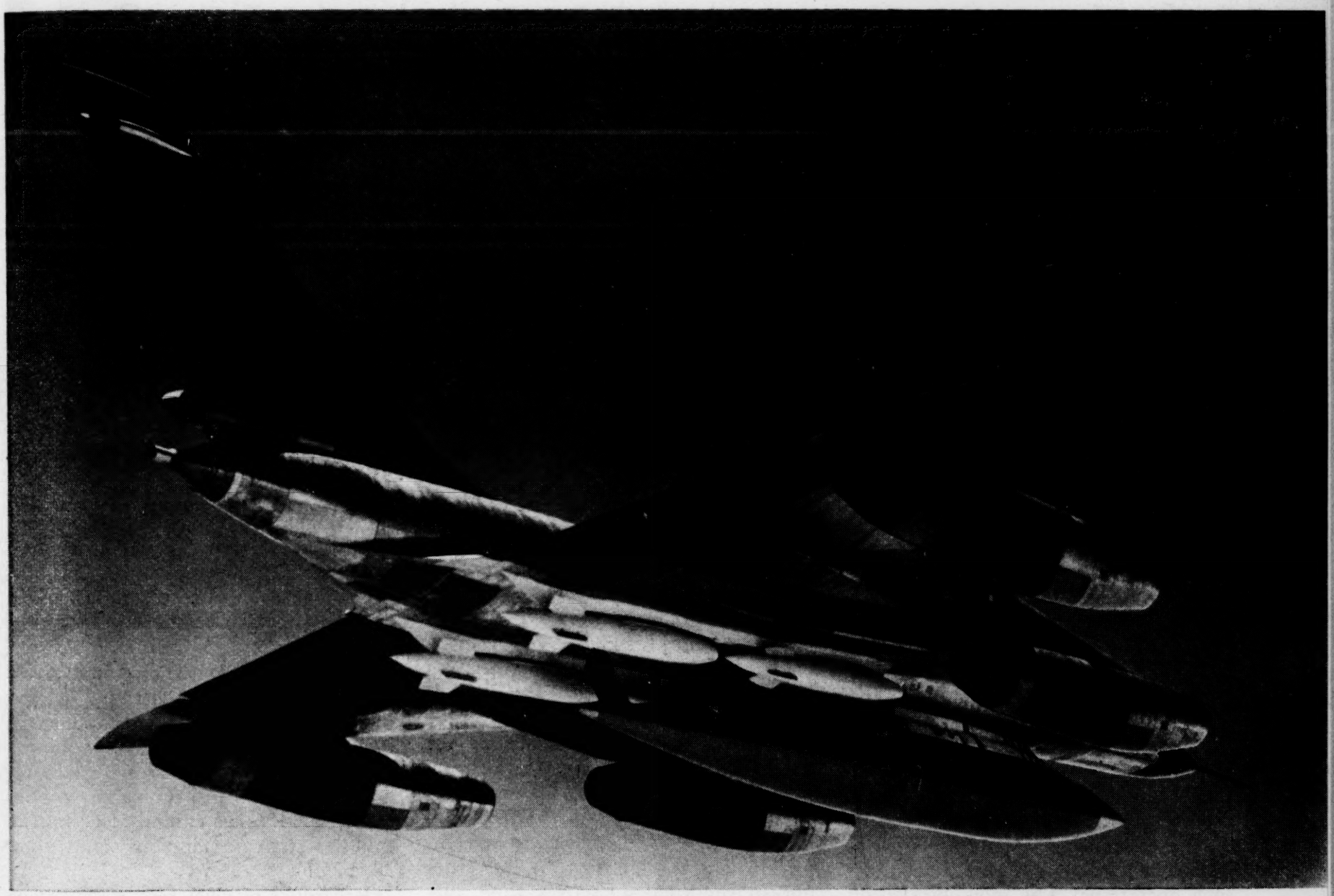
Northeast Airlines led the industry in traffic gains. Total revenue passenger miles climbed 60% in March, compared with the same month last year. First class revenue passenger miles for the carrier rose 85%, followed by Delta with a 36% increase in this category of traffic. Northeast's coach revenue passenger miles climbed 46%, but Continental, which had a 13% decline in first class traffic, experienced a 53% increase in coach traffic. In this traffic

Growth Of Coach Traffic

Domestic Trunkline Carriers 1959-1960

(in thousands)

	First Class Revenue Psgr Miles		Change Per Cent	Coach Revenue Psgr Miles		Change Per Cent	First Class Available Seat Miles		Change Per Cent	Coach Available Seat Miles		Change Per Cent	Coach as a Per Cent of Total Traffic	
	1960	1959		1960	1959		1960	1959		1960	1959		1960	1959
Big Four Carriers	9,719	10,522	−7.7	10,367	8,849	17.1	16,896	17,149	−1.5	15,637	13,193	18.5	51.7	45.9
Other Eight	5,126	5,330	−3.9	3,997	3,309	20.8	9,558	9,505	.5	7,012	5,738	22.2	43.8	38.5
American	3,458	3,532	−2.1	2,799	2,082	34.0	5,670	5,208	8.9	3,919	2,770	41.4	44.7	37.1
Braniff	704	770	−8.7	348	163	112.7	1,275	1,355	−5.9	579	251	130.3	33.1	17.5
Capital	1,141	1,313	−13.1	350	297	17.7	2,051	2,207	−7.1	763	550	38.7	23.5	18.5
Continental	479	441	8.5	405	230	76.0	1,005	852	17.9	755	375	101.4	45.8	34.3
Delta	1,027	895	14.7	804	660	21.8	1,771	1,536	15.3	1,315	1,188	10.6	43.9	42.4
Eastern	1,888	2,225	−15.2	2,134	2,126	.4	3,769	4,577	−17.7	3,937	4,027	−2.3	53.3	49.8
National	419	517	−19.1	597	548	8.9	921	1,018	−9.5	971	897	8.2	58.7	52.9
Northeast	273	230	18.3	291	288	1.3	479	418	14.6	617	612	.7	51.7	55.5
Northwest	558	617	−9.5	777	766	1.4	1,113	1,181	−5.8	1,316	1,309	.5	58.2	55.4
TWA	1,880	2,142	−12.3	2,570	2,437	5.5	3,247	3,206	1.3	3,714	3,286	13.0	57.7	53.2
United	2,492	2,623	−5.0	2,862	2,204	29.9	4,209	4,157	1.3	4,066	3,108	30.8	53.4	45.6
Western	522	542	−3.7	421	353	19.3	939	934	.5	693	552	25.5	44.6	39.4
Total Trunkline	14,845	15,853	−6.4	14,365	12,159	18.1	26,454	26,654	−.8	22,649	18,931	19.6	49.2	43.6



Convair Studies Additional Nuclear Weapons for B-58

USAF has given Convair's Ft. Worth division $1 million to study feasibility of carrying four small nuclear weapons in addition to its large weapons-fuel pod. Rep. Jim Wright (D.-Tex.), requesting the House Armed Services Committee to put money into Defense Department's Fiscal 1962 budget for manned bombers, said addition of these stores would increase B-58's total nuclear yield to 15 megatons. Contract covers modification of the B-58 shown above, location of stores, ballistic studies, etc. Three flights have been made so far. Hustler still has supersonic dash capability with this load, suffers range penalty of less than 10%. Rep. Wright said development plus two operational wings had cost $3 billion but a third wing could now be bought for about $340 million more. He said unit price after the first 200 aircraft would be less than that for the Boeing B-52. Purchase of B-58s through Fiscal 1961 is 97 aircraft.

class, it was followed closely by Capital, United's merger partner, with a 43% coach traffic gain. Capital's first class traffic fell 5%.

Braniff's first class traffic dropped 11.6%, while coach traffic for the month rose 26%. Braniff restricted its capacity, with a 19% cut in first class available seat miles and 0.3% increase in coach available seat miles. National cut March total available seat miles 14% from the March, 1960 level.

Best load factors reported for the month were 61% for National and 60.8% for United. Industry load factor was 57.13%, a 1.27 point increase from the industry load factor in March, 1960. During 1960, the industry load factor fell consistently each month except in April, when a 0.6 point gain was registered.

Available seat miles, or seat capacity offered by the trunkline fleets, resumed the steady rise which began early in 1959 when jet transports first came into service. First and only decline in available seat miles during the past two years occurred in February during the flight engineers' walkout.

First class trunk industry load factor in March was 54.7%, compared with 54.5% the previous March. Coach load factor for the industry was 59.8%, a gain over the 58.2% for March, 1960. National led the industry with a 68% coach load factor. Delta reported a 65.3% load factor, United 66.5%. Only Delta passed the 60% mark in the first class category with a 61.6% load factor. Closest contenders were Capital with a 58.8% first class load factor and Braniff with a 57.9% load factor.

In 1960, coach traffic accounted for 49.2% of all traffic carried, compared with 43.6% in 1959. Last January coach service was 52.9% of all traffic, compared with 44% in the same 1960 month, and in February it was 51.6% of total traffic, compared with 43.9% in the same month last year.

During 1960, six trunklines—Eastern, TWA, United, National, Northeast and Northwest—carried more coach traffic than they did first class traffic. Four other trunklines—American, Continental, Delta and Western—reported coach revenue passenger miles in excess of 40% of all traffic. Coach traffic of Braniff and Capital during the year accounted for 33% and 23% respectively of all traffic carried by each airline.

Braniff led the industry in 1960 in the expansion of coach traffic. The carrier increased its coach revenue passenger miles by 112% during the year. Continental was second with a 76% increase, American third with a 34% increase, United fourth with 29%.

During the first quarter of 1961, coach represented 52.5% of all traffic for the 12 trunklines, compared with 44.3% in the first quarter of 1960. The industry generated 6.5 billion passenger miles during the first three months, a drop of 4.3% from the first quarter last year. Available seat miles for the trunklines during the period were 11.3 billion, a 5% decrease from last year.

Confusion Hampered Military Aid in Cuba

By Larry Booda

Washington—Bitter comments of military men, contrasted with candid appraisals by high Administration officials, marked the aftermath last week of the abortive rebel invasion of Cuba which was conceived and directed by the U. S. government Central Intelligence Agency.

The Joint Chiefs of Staff, which a year ago had called such an operation feasible with proper military support, had since been relatively uninformed about the closely held plans for the operation.

Not until panic developed two weeks ago, when the mission appeared to be going badly, were defense officials told to provide support, and then in such a manner that pilots and ship commanders could not be briefed properly on what they could and could not do to render assistance.

CIA Probe

In the aftermath of this unsuccessful venture into clandestine military operations, President John F. Kennedy appointed retired Army Gen. Maxwell D. Taylor to conduct a government-wide probe of the country's ability to conduct such operations. The move headed off any immediate congressional investigations.

Of the approximately 1,300-man Cuban rebel force which made the landings, apparently about a third were captured, a third were evacuated and a third joined guerrillas already operating in Cuba.

In a rash of "background" and "off-the-record" sessions with the press, high government officials soon revealed that there has been sharp disagreement since the January change of administrations concerning the Cuban operation. These officials appeared to be generally candid, but there were indications of a lack of national doctrine on participation in guerrilla, or para-military, operations.

Episode of Confusion

These facts have emerged from the confusion that still surrounds the episode:

- **What was to have been** only a resupply mission for guerrillas already fighting in the Cuban mountains and a test of defense strength on the Cuban mainland was turned into a full-scale "invasion" by over-enthusiastic publicity concerning the strength of the rebel effort.
- **An air raid on Havana** several days before the landings warned Premier Fidel Castro of the planned landings and permitted him to mobilize and otherwise prepare for action. In a later broadcast, he said that he could not understand why the invasion was not started the same time as the air raid instead of giving him time for preparation.
- **Air operations in support** of the landings ceased abruptly when one B-26 was shot down. The remaining B-26 aircraft fled. The area of landing action, a swampland about 90 mi. southeast of Havana, had been the scene of public works which resulted in good roads capable of taking the Russian-built tanks of the Cuban Army. A single break in each of the roads from aircraft bombs would have been enough to impede the tanks.
- **Despite reports** to the contrary, no Soviet-built MiG fighters were operated by the Castro forces. Only jet aircraft available were Lockheed T-33 single-engine trainers fitted with guns and bomb racks, plus a few British-built Sea Fury naval aircraft. Three of the T-33's were primarily responsible for the casualties and damage to the invasion forces.
- **An estimate of the will** of the Cuban people to revolt was revealed to be completely in error. Neither in the cities nor in the rural areas was there any sign of a mass desire to abandon Castro, probably because of police-state security measures.
- **The term "para-military operations"** has suddenly been thrust on the military services, who had in the recent past had relatively little to do with clandestine military activities.

Investigating Group

Assisting Gen. Taylor in the survey of intelligence and para-military capability will be Attorney General Robert F. Kennedy, Central Intelligence Director Allen Dulles and Chief of Naval Operations Adm. Arleigh Burke.

In appointing the former Army Chief of Staff, President Kennedy said that the country has much to learn from the events connected with Cuba and that we must "reorient our forces, our tactics and our institutions" to intensify the struggle against Communism.

Robert Kennedy has had experience in the field of government agencies and operations as former chief counsel of the Senate Government Operations Committee.

Pentagon observers indicated Adm. Burke was appointed because defense officials and the President have been impressed with the objectivity of his intelligence briefings for top Navy officers and with his campaign for objective analysis of intelligence in relation to strategic targeting (AW Jan. 30, p. 21).

Regardless of what recommendations Gen. Taylor gives the President and what recommendations are passed on to Congress, the Cuban incident revived discussion of the need for a congressional watchdog committee for CIA that has arisen repeatedly during the 14 years since the agency was organized.

Separating Functions

Former Vice President Richard Nixon, who discussed the situation with the President, reportedly feels the CIA should divide its responsibilities, separating its gathering of information from its operations.

Air operations of the rebel forces first consisted of a raid by B-26s from outside Cuba on airfields where it was reported that Soviet-built MiG fighters were being uncrated and assembled. Two days later, they made their abortive attempt at bombing roads.

Air cover for the rebel aircraft was a hastily organized operation. The Joint Chiefs of Staff were instructed only days before to provide fighter aircraft to cover the bomber operations. Policy guidance for these operations was so indefinite and shifted so rapidly that Air Force and Navy commanders could not brief pilots on when, where or at whom they could shoot.

Air cover was also supposed to be provided for the invasion fleet, which consisted of about eight freighters and

Zeus Target Contract

Los Angeles—Contract will be awarded soon for special Atlas ICBM nose cones to be used as targets in test of Army's Nike Zeus anti-ICBM missile from Kwajalein. Competitors for the Air Force Ballistic Systems Division contract, expected to total about $10 million, include Chrysler, General Electric, Avco and Aerojet-General.

Target re-entry vehicles will be fired by Strategic Air Command from Vandenberg AFB, Calif., to be intercepted by Nike Zeus test vehicles fired from Kwajalein. Tests are scheduled to begin late this year. Titan ICBMs also will be used as launch vehicles later in the program.

Under the Army-Air Force agreement covering the Nike Zeus trials, initial nose cones will not be operational types but will be relatively unsophisticated targets. The re-entry vehicles then will progress to the operational types required for realistic interception. This would mean decoys will be used toward the end of the test series.

numerous small craft. However, lack of guidance prevented effective aid for the invasion force. When some of the invaders were driven back to the sea, U. S. Navy destroyers and destroyer escorts aided in rescue operations.

Reaction among military officers was that if they had been consulted in time, they could have provided more effective support for the operation.

Defense Department believes involvement of regular military forces in guerrilla operations in another country is a "gray area" which will have to be studied at length from legal, prestige and diplomatic standpoints.

Para-military operations pose a question of how much the Department of Defense should openly participate, compared with activities of special units. Para-military operations are considered distinct from legal operations under treaties such as South East Asia Treaty Organization, where military assistance and training are carried on in the open. Assignment of such a mission to the military is so new that no doctrine is available for use as a guide.

Immediate reaction to the failure of the operation was one of bipartisan support for the Administration and little criticism. President Kennedy solicited and received support from former President Dwight D. Eisenhower, former Vice President Nixon, New York Governor Nelson Rockefeller and former President Harry Truman.

Secretary of the Interior Stewart L. Udall broke the calm with a statement in a television interview that the operation was conceived and planned by the Eisenhower Administration. President Kennedy immediately disavowed any such placing of blame by saying that he was fully responsible for all decisions since he took office Jan. 20 and was fully cognizant of planned operations before that.

Kennedy Seeks U.S. Space Race Gains

By Ford Eastman

Washington—Swift re-examination of national space goals in an apparent effort to find areas where the U.S. might beat Russia to some spectacular space achievements has been ordered by President Kennedy.

The new look at the space program was ordered following Russia's successful orbiting of a man in space and strong congressional urging that the U.S. space program be accelerated.

At the same time, the President signed into law a bill which amends the national space act and provides that Vice President Lyndon Johnson become chairman of the National Aeronautics and Space Council. The council is charged with making the new review and reporting back to the President "as soon as possible"—a time estimated at two to three weeks.

One of the major areas where a reexamination of policy will be made is in the development of big boosters, the President said at a press conference earlier. A decision must be made whether emphasis should be placed on chemical or nuclear rockets, taking into consideration cost and which approach offers the U.S. the best possibility of meeting its power requirements in the future.

Kennedy View of Saturn

The President said that additional funds had been requested to accelerate Saturn, but that "regardless of how much money we spend on Saturn, we are still going to be second. . . . The question is whether the nuclear rocket or other kinds of chemical rockets offer us a better hope of making a jump forward, but we are second and Saturn will not put us first. . . .

"In addition," he said, "we have to consider whether there is any program now, regardless of its cost, which offers us hopes of being pioneers in a project. It is possible to spend billions of dollars in these projects in space to the detriment of other programs and still not be successful. . . . Now I don't want to start spending the kind of money that I am talking about without making a determination based on careful scientific judgments as to whether a real success can be achieved or whether we are so far behind now in this particular race we are going to be second in this decade."

Signing the space act amendments, the President said: "Enactment of this measure is symbolic of our government's intention to translate leadership and determination into action. . . . Working with the Vice President, I intend that America's space effort shall provide the leadership, resources, and determination necessary to step up our efforts and prevail on the newest of man's physical frontiers."

This apparently reflects a change in the attitude that prevailed in March when the Administration turned down $182.5 million of the $308-million increase asked by the National Aeronautics and Space Administration over the $1.1 billion requested in the Eisenhower budget for Fiscal 1962.

CIA Briefing

Allen W. Dulles, director of the Central Intelligence Agency, and Dr. Herbert Scoville, a CIA official, told the House space committee last week in a closed briefing that there is little doubt the Russians orbited a man in space.

Chairman Overton Brooks (D.-La.) said at the end of the briefing that he had always felt they had made the successful flight and that the briefing had not changed his thinking. He added that he had not learned of any new conclusions, although some of the Russian methods he had been briefed on were new.

In a detailed summary submitted by NASA to the House space committee at the request of Chairman Brooks, the budget approved as of Jan. 16 was $1,109,630,000. On Mar. 17, after President Kennedy took office, NASA requested an amended budget of $1,417,821,000, and on Mar. 28, the amount approved by Budget Bureau was $1,235,300,000 (AW Apr. 24, p. 31).

Cuts made by the Budget Bureau in NASA's amended requests for research and development included $5 million for life sciences, $13 million for scientific satellites, $25 million for lunar and planetary exploration, $12 million for meteorological satellites, $42.6 million for Project Apollo, $8 million for launch vehicle technology, $5 million for solid propulsion and $8.5 million for nuclear systems technology.

Increases Approved

Among increases approved were $56.4 million for Saturn, $30.8 million for Centaur and all but $880,000 of the $10.2-million increase asked for liquid propulsion.

The total amount requested for research and development was $1,056,309,000, of which $919,539,000 was approved but which still represents a $99,720,000 increase over the amount approved by the Eisenhower Administration.

Of the $152,002,000 requested for construction and facilities, the Budget Bureau approved $119,075,000, a cut of $32,927,000 but about $20-million more than President Eisenhower asked.

Rejected by the Kennedy Administration were requests for $17.5 million for the Lewis Research Center, $1.3 million for the F-1 engine program, $15 million for the nuclear rocket program and $5.1 million for the manned space flight tracking network. An increase requested and approved was $4 million for the Marshall Space Flight Center.

For salaries and expenses, the Budget Bureau allowed 780 positions more than the Eisenhower Administration requested, but denied another 1,432 asked by NASA in March. Nearly $13 million was cut from the total funds requested.

Manned Mercury Test Set Despite Failure

Washington—U. S. planned to make the first manned rocket flight in its space program this week, using a Mercury-Redstone booster, despite the failure last week of the first attempt to put a Mercury capsule into orbit.

The manned, suborbital shot is to boost a Mercury capsule to an altitude of 115 mi. and a distance of 290 mi. in a 15-min. test of an astronaut's ability to withstand the force of liftoff, powered flight, some 5 min. of weightlessness, and entry and landing phases.

The attempt to put a Mercury capsule containing a "mechanical astronaut" into a single orbit around the earth was aborted when the Atlas booster failed to roll to its intended 70-deg. heading and pitch over into its trajectory.

The Mercury-Atlas vehicle, designated MR-3, was launched at 11:15 a.m. on Apr. 25 from Cape Canaveral, Fla., after a normal countdown involving two minor holds. The Atlantic Missile Range's safety officer initiated the abort when the Atlas was at approximately 15,000 ft.

The vehicle's Abort-Sensing and Implementation System activated the capsule's escape rockets. After a brief delay, the Atlas was destroyed and the capsule coasted upward to 24,000 ft. The capsule's landing system operated successfully, deploying parachutes and lowering the capsule into the Atlantic Ocean at 11:22 a.m. about 350 yd. off the Cape and 2,000 yd. north of the launching pad.

Capsule Recovered

At 11:33 a.m., a helicopter retrieved the capsule, delivering it to the forward medical site at Cape Canaveral at 11:43 a.m. Had the capsule contained a man, an emergency medical team would have been on hand at this site.

Two-way, air-to-ground communication with the McDonnell capsule was maintained from liftoff through the time it hit the water. The capsule carried two playback tape recorders, each with pre-recorded voice messages of 45-min. duration.

National Aeronautics and Space Administration officials said operation of the abort sensing system and the escape system were completely successful. After initial examination of telemetry data and examination of the capsule, they said they intended to go ahead with the Mercury-Redstone flight this week if more careful examination of telemetry records did not produce unfavorable information.

Robert R. Gilruth, director of NASA's Space Task Group, also said at a press conference held a few hours after the abortive flight that "today's flight will in no way change our plans to stick with the Atlas booster for this [Mercury] mission."

The Convair-built Atlas booster used in the Mercury program originally was to have been a very slightly modified USAF Atlas D missile. Prior to last week's shot, the Atlas had had one successful and one unsuccessful flight in the Mercury program.

Gilruth Supports Atlas

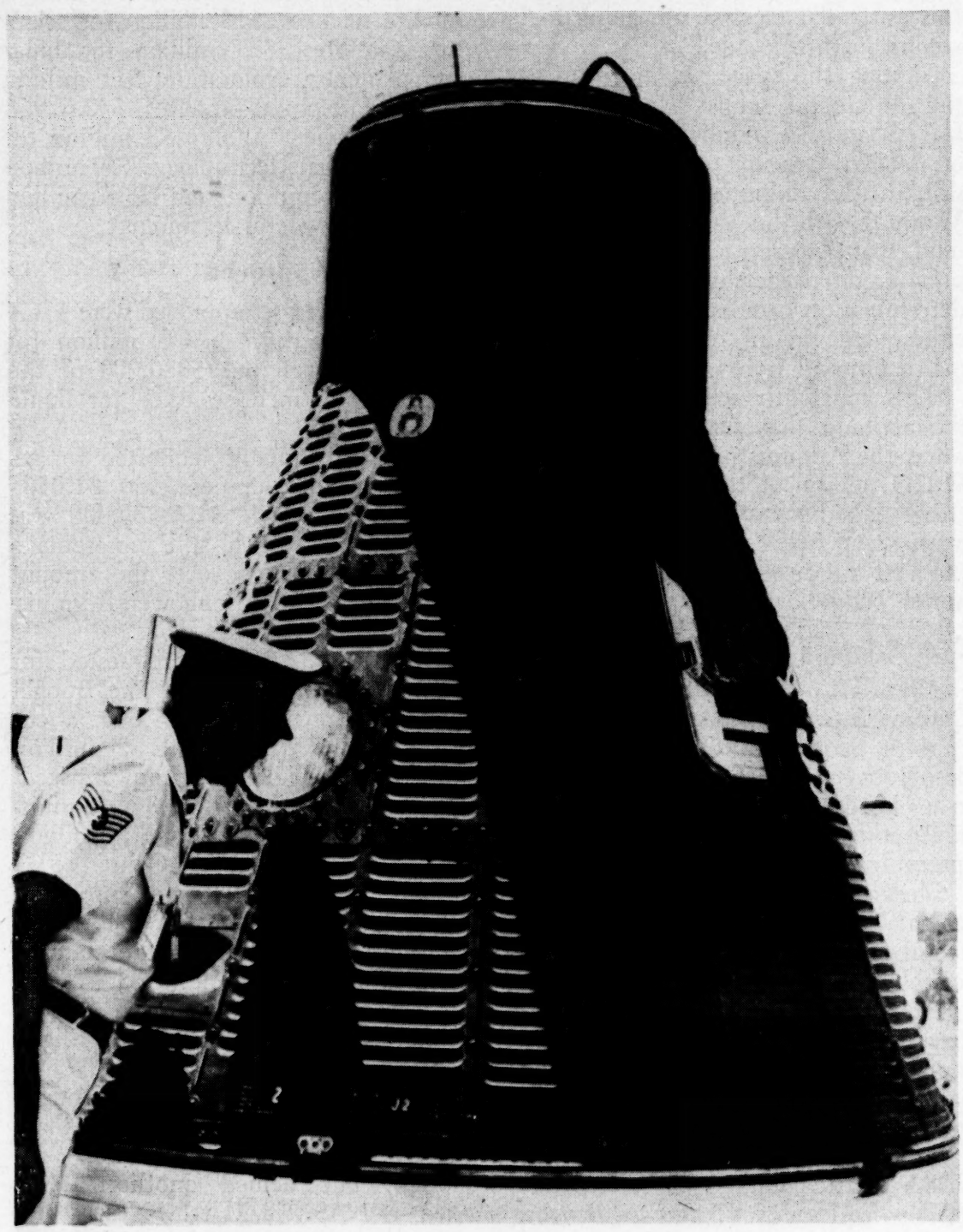
When the Wiesner space task group suggested last January that the Atlas might be marginal for the Mercury mission and suggested the possibility of using the USAF-Martin Titan as a backup, Gilruth stood by NASA's decision to use Atlas.

He said it was further ahead in development and said time required to integrate a new vehicle into the program would be very substantial. NASA did order a strengthening of the skin at the upper portion of the Atlas, and the MA-3 contained this modification.

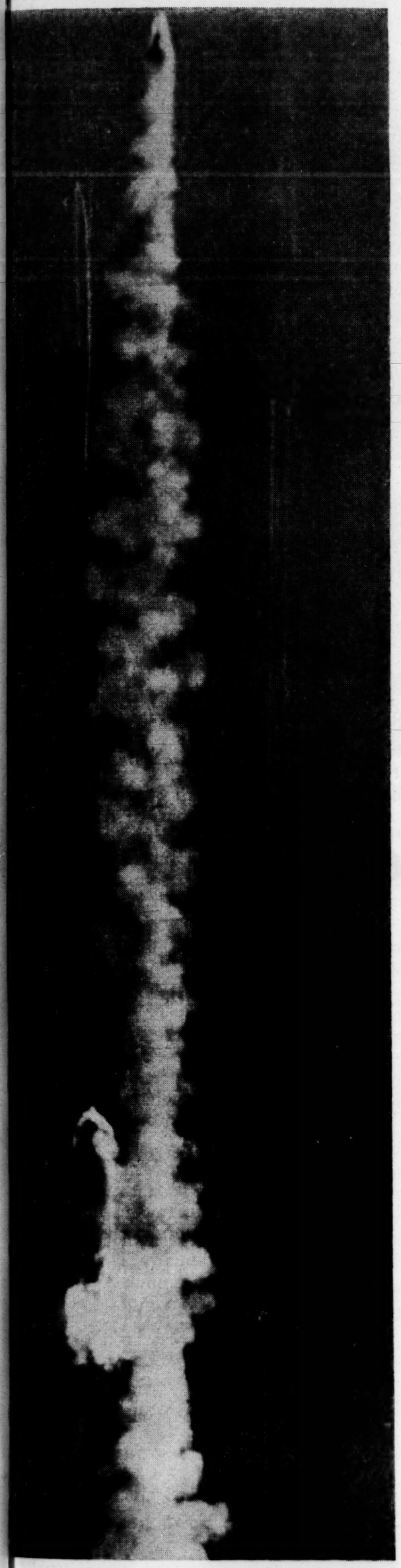
Fault in the MA-3 flight apparently lay in the Convair-built flight programmer, which has control of the vehicle from liftoff until the two outboard Atlas engines are separated. From separation until burnout of the sustainer engine, flight is controlled by the GE-Burroughs radio command-inertial guidance.

Col. Paul Wignall, commander of Air Force Ballistic Systems Division's 6555th Test Wing, said a few hours after the shot there was no difficulty with the programmer during the countdown and said "neither of the two holds we had for the booster were connected in any way with the flight control system as far as the data that we have available to us now would indicate."

Col. Wignall said the flight control system which contains the programmer



MERCURY capsule was saved by emergency escape system in abortive launch attempt and NASA officials said an astronaut would have been unharmed by the flight.



Destruction of Atlas was initiated when vehicle was at 15,000 ft., but an automatic delay allowed abort sensing system to activate emergency capsule escape system, separating capsule from booster safely.

"has been flown on a large number of occasions. We have had no previous malfunctions of this particular nature in the entire Atlas program."

The MA-3 flight was to have been the first complete exercising of the entire system that will put the first U. S. astronaut into orbit, with the one exception that a crewman simulator took the place of the astronaut. This system was designed to put the same loads upon the capsule's environmental control systems as a man would. It would remove oxygen and add carbon dioxide and water vapor to the recirculating oxygen stream, in effect duplicating the astronaut's circulatory and respiratory functions. An electrical heating element would simulate body heat.

Flight was to have lasted approximately 110 min., carrying the capsule in a 100-mi. high orbit at 17,500 mph. Recovery was planned for an area some 300 mi. east of Bermuda. Recovery forces in the Atlantic consisted of 13 ships and 21 aircraft, spread from Cape Canaveral across to the Canary Islands.

As it was, the test provided the first check of the worldwide Mercury communications network in its initial operations. Stations were connected with the communications and computing center at the Goddard Space Flight Center near here and with the Mercury flight control room at the Cape.

The Mercury-Redstone flight scheduled this week will give the pilot more chance to test manual operation of the capsule's flight control system than Russian cosmonaut Maj. Yuri Gagarin apparently had. The U. S. astronaut also will carry out a number of other tasks designed to test his or the spacecraft's capabilities.

During most of the re-entry phase, control is automatic, but the pilot returns to manual control for rotation of the capsule on its longitudinal axis, which is necessary to reduce oscillation and landing dispersion.

NASA also planned for late last week another attempt at testing the Mercury escape system under maximum dynamic pressure conditions, firing a Little Joe VII booster with a production line Mercury capsule from its Wallops Island, Va., station. Escape sequence was to be initiated at about 35,000 ft. No test so far has subjected the escape system to the most severe conditions possible in an orbital launching.

West Germans Consider Ordering Martin Pershing Instead of Mace

Washington—West German air force team has completed a technical evaluation of the Army-Martin Pershing tactical missile and the group's report is expected to be followed by a German order.

The team, headed by Brig. Gen. Kurt Kuhlmey, chief of plans and operations for the German air force, was briefed by the Air Force and Army here along with another group headed by Volkmar Hopf, state secretary of defense in the West German Defense Ministry.

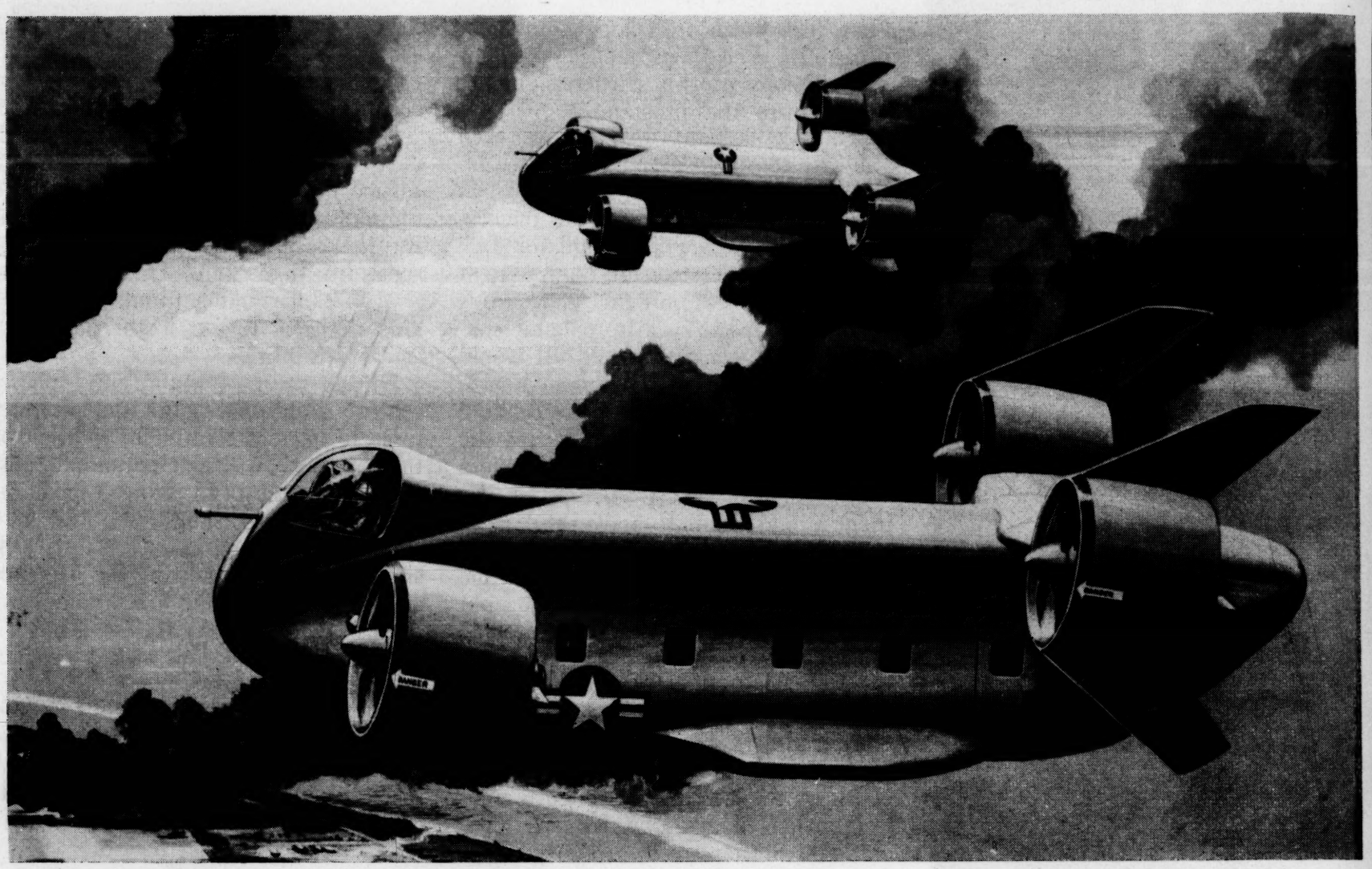
Both of the groups later moved on to Martin's Orlando, Fla., plant, where Pershing is under development, and to the Atlantic Missile Range, where a Pershing test vehicle was fired 250 mi. Apr. 21, dropping its nose cone in its target area. Missiles in the current, or third, test series are shorter than the previous 14 fired, and the Apr. 21 vehicle launched a new version of the sharply tapered Pershing nose cone. Fourth and final series will test the operational missile, which will be still shorter than the current series. Tests will be programmed as far down range as 400 mi., and some will be fired as far as possible to determine maximum range.

German interest in Pershing coincides with a decision to abandon plans to order the USAF-Martin Mace as the West German tactical missile system. Both decisions require North Atlantic Treaty Organization approval.

Martin Board Chairman George Bunker noted that there had been reports of the German plans at the company's annual stockholders' meeting. At the same time, general counsel Clarence Miles announced that Martin was negotiating to dispose of most of its 241,209-share interest in General Precision Equipment Corp.

General Precision had taken court action to block Martin control of the company through its approximately 15% interest. Bunker commented that management's job is to promote growth rather than become involved in "legal entanglements" in discussing the negotiations. The stock is to be sold to the public in conjunction with a General Precision public stock offering. Martin paid about $11 million for the stock, which last week had a market value of about $16 million.

Bunker also reported that Martin's sales in the first quarter of 1961 were $198,248,575 with a profit of $4,914,690, compared with a profit of $3,488,122 on sales of $140,839,907 in the first quarter last year.



TANDEM ducted-propeller transport conceived by Bell Aerosystems illustrates the concept Bell and Lockheed Aircraft Corp. are proposing in the tri-service transport competition. Douglas also is reported as proposing a tandem configuration.

10 Bidders Seek Tri-Service Contract

Six of the ten companies submitting proposals for the tri-service transport have chosen either ducted propellers or tilt wing configurations to meet the divergent requirements of speed, range, payload and carrier deck operation.

Design proposals went in to the Department of Defense early last month, and cost and management proposals were submitted at mid-month.

At least two proposals—one of the two alternate configurations submitted by Douglas Aircraft Co. and one by Bell Aerosystems Co. and Lockheed Aircraft Corp.—involve similar ducted fan concepts. This is understood to be a tandem wing aircraft with engine-propeller shrouds at each of the four wingtips.

At least four others, Grumman-Kaman, McDonnell-Canadair, Boeing-Vertol and Chance Vought-Ryan-Hiller, involve some form of tilt wing with either a conventional propeller or a fully articulated rotor-propeller, and with various types of leading or trailing edge flaps.

Because of the shroud's function to some degree as an airfoil, the wing span can be short, thereby eliminating the need for wing folding to meet the carrier requirement.

Douglas has purchased the Doak Model 16 test and engineering data and hired two key Doak engineers. The Doak testbed (AW June 8, 1959, p. 34), now owned by the National Aeronautics and Space Administration, uses tilting ducted fans at the tips of a conventional wing and reaction control for hovering.

Tandem Configurations

Tandem configurations need no auxiliary control systems for VTOL flight, but various forms of these will be seen in more conventional proposals, including tip-driven propellers, tail rotors or small gas generators in the tail.

Fuselages will be boxes to gain maximum volume within the confined dimensions of the specifications (AW Feb. 27, p. 33). The Chance Vought-Ryan-Hiller proposal may be typical. Mockup of this design—designated V-447—shows use of a high wing, a cockpit with good visibility with the crew in high seats looking over a short stubby nose, and rear loading with an integral downward swinging ramp.

Though Chance Vought has experimented with a design using four Pratt & Whitney J60 engines driving ducted fans called ADAM (air deflection and modulation), the proposal does not use this particular propulsion concept.

Boeing-Vertol and Boeing-Wichita both submitted proposals. The Vertol proposal was in cooperation with Boeing's Transport Division and is based on extensions of Vertol's work with its Model 76 tilt wing test bed. The Wichita proposal reportedly is highly sophisticated and involves a variable geometry wing.

Bell Helicopter reportedly has submitted a proposal involving rotary wing, possibly based on its XV-3 tilting mast testbed. Sikorsky Aircraft's proposal does not involve rotary wing.

Neither Convair Division of General Dynamics nor Republic Aviation entered, but Canadair, a subsidiary of General Dynamics, is teamed with McDonnell Aircraft Corp. Grumman Aircraft Engineering Corp. and Kaman Aircraft Corp are bidding as a team, and North American Aviation Columbus Division also has an entry.

Team Approach

Kaman's previous work on the K-16 tilt wing and flap combination (AW Jan. 11, p. 121) is probably indicative of the team's approach. Grumman is primarily responsible for the design, and Kaman is contributing its rotor-prop development and other VTOL experience.

McDonnell-Canadair also are understood to have a tilted flapped wing approach with two conventional propel-

lers driven by four General Electric T64 engines. Most proposals were submitted with this engine, which has been developed with Navy funds.

A complete study was done by McDonnell on a compound helicopter configuration, but it was not submitted as a proposal since this configuration could not approach the speed requirement though it could meet other performance categories.

Some previous work by Bell Aerosystems, extending back to 1953 and which led to the design of Bell's Model D190B tilting ducted fan proposal for a USAF unfunded rescue aircraft requirement SOR-187, also throws some light on its design considerations for the tri-service transport.

Bell has done detail studies on five possible configurations:

- **Tilting unflapped wing.**
- **Tilting flapped wing,** less than 90 deg. tilt.
- **Tilting propeller.**
- **Fan in wing.**
- **Tilting ducted fan.**

The tilting unflapped wing has obvious weight advantages, but might also involve control problems in transition. The tilting propeller requires blade folding on board a carrier. Fan-in-wing looked better for low hovering time, higher speed applications.

Proponents of tilt wing configurations point to these considerations:

- **Power requirements** of a tilt wing configuration are lower in transition and at low speeds.
- **Full efficiency** of ducted propellers may depend heavily on both variable geometry inlets and exhausts.
- **Interference drag** between ducts and fuselage in short span configurations may become a problem.
- **Duct icing** could be a tougher problem than icing of an unshrouded propeller.

Bell's earlier studies of ducted propellers led it to conclude that since the ducted propeller-turboprop engine combination results in a 30-50% increase in static thrust over the same unshrouded combination, that about 50% of helicopter hovering efficiency was obtainable, and that speed capability up to 500 mph. was possible.

In the years since the studies began in 1953, various VTOL transport and utility aircraft were studied:

- **D182C twin-duct** test aircraft proposed to Office of Naval Research in 1956 using major components of the Cessna T-37 jet trainer. Powerplants were two General Electric T58 turboprop engines of 6,270 lb. gross and carrying a crew of two. Reaction controls at the fuselage tailpipes were used for pitch and yaw. Ailerons located aft of the ducted propellers were split for roll control at hover.
- **D196 observation aircraft** designed to a Navy specification. It also utilized two fuselage mounted T58s, had a gross weight of 7,630 lb., top speed of 282 kt. at 5,000 ft.
- **D190B interim transport** proposed for the USAF rescue requirement.

This high wing, twin-rudder aircraft, also a twin rotatable duct design, is much smaller than the tri-service transport, grossing only 14,150 lb. VTO. But the speed and range specifications—385 kt. at sea level and a VTO radius of 594 naut. mi., which can be increased to 1,050 mi. using maximum STO weight of 17,430 lb., approach the tri-service transport performance spectrum.

Powerplants are two Lycoming T55-L-5 engines mounted in the fuselage. Ducted propellers at the wingtips are interconnected by a cross shaft.

Ducts in this airplane use a variable geometry inlet provided by extensible flaps Bell studied in 1956 in an ONR-sponsored wind tunnel test program at the University of Wichita. The flaps increase the camber of the shroud for better performance at hover.

The airframe is conventional, using magnesium and titanium where possible for weight saving. Conventional two spar wing structure without leading edge flaps or slats is used. Wing thickness is 15%.

Six-bladed propellers in each duct contrarotate and are driven at a maximum 2,400 rpm., reduced from maximum engine rpm. of 6,625 through gearing at a center transmission in the fuselage.

Latest Bell studies, for various categories of V/STOL transports under Air Force Study Requirement SR-175, call for mounting engines in the duct centerbody. The centerbody must be relatively large in any event for aerodynamic reasons. Besides the D190B, these designs include:

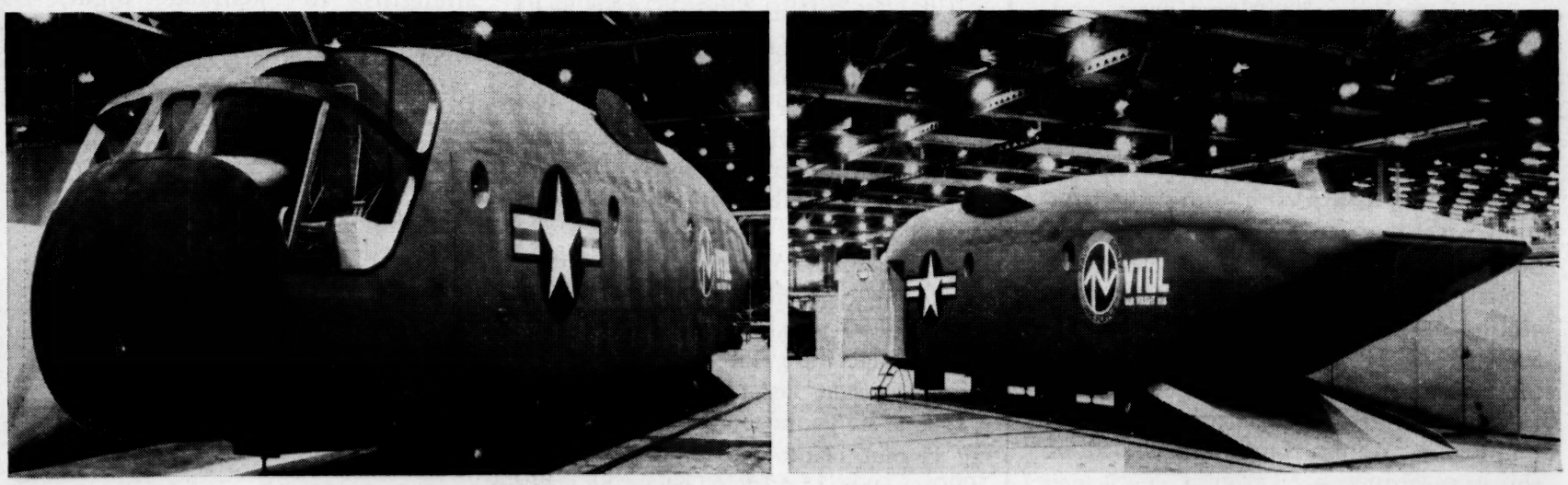
- **D181 medium transport** with six Allison 550-B1 engines mounted in centerbodies, two engines each in the two wing tip ducts, and a single engine in each of the two inboard ducts. The paired engines drive contrarotating propellers, the inboard single engines, single propellers. A GE J85 turbojet engine in the rear fuselage provides low speed reaction pitch control. Empty weight is 52,040 lb. and VTO gross weight 79,350 lb. Maximum speed is 445 kt. at sea level and VTO radius is 467 naut. mi.
- **D2005 heavy transport** powered by eight Allison 550-B6 engines, two to each of the four ducts. Empty weight is 69,900 lb., and VTO gross weight 120,200 lb. Performance is similar to the D181, but two J85s are required for low speed pitch control.

Bell has studied the tandem duct configuration for an assault transport under the designation D2022.

In a tandem configuration, propellers would still be interconnected for engine-out performance. Bell studies indicate such a configuration, with a 20-25 ft. rear wing span including ducts, could maintain altitude in horizontal flight using three engines, and hover on three engines at lower weights than maximum.

Since the propeller in the engine-out duct still would be providing thrust through interconnection, Bell estimates a 17% reduction would be sufficient.

Ducts are heavier than unshrouded propellers, but Bell believes this factor is offset by the smaller propeller diameter permitted by ducts producing higher propeller rpm., and shorter, lighter landing gear requirements.



FRONT and rear views of Chance Vought-Ryan-Hiller V-447 fuselage mockup show stubby, boxlike configuration to meet volume requirements in a relatively small dimension. Such fuselages will be typical of designs submitted in the competition.

Better Bioastronautics Research Urged

By Edward H. Kolcum

Chicago—Bioastronautics research capability and accomplishments are increasing, but unless management of all United States programs is consolidated, "we'll never catch up with the Russians," according to Brig. Gen. Benjamin A. Strickland, command surgeon for the Air Force Systems Command.

Gen. Strickland told AVIATION WEEK that space medicine research now is "being diluted by fragmentation," and he suggested strong single point control and elimination of the multitude of interagency committees which now exist among government agencies engaged in bioastronautics research.

Strickland made these points during the 32nd meeting of the Aerospace Medical Assn., where 184 scientific reports were given last week at three simultaneous sessions. Reports covered investigative and clinical studies in pathology, operational medicine, physiology, thermal stress, accelerations, medical electronics, simulators and radiobiology.

Obvious feeling at the meeting expressed by several industry and Defense Department representatives was the status gain being made by the medical profession in space and aeronautical research. Strickland said, "Hardware people in general are accepting the fact that they get into a horribly expensive retrofit program" unless the design phase includes human factors needs.

Col. Karl H. Houghton, chief of the Aerospace Medical Division in the USAF Surgeon General's office, said that engineers are gradually realizing "we pay our way." Houghton said past differences between hardware and medical professions are being dissipated by a growing mutual respect which will be helped further when the disciplines reach a common language. Air Force has started a program of cross-training in which aeromedical specialists attend an engineering school two years and write a thesis on joint problems.

Houghton also looks for an amalgamation of the life sciences effort because there is a shortage of people to do the work. He said available scientists are devoting considerable effort to the total programs, but there is a need for better integration.

Strickland feels the Air Force has the ability to provide full support to the total national space program, using complete resources in the country. He said, however, that single strong management is more important than who does the managing.

The increased stature of bioastronautics research was demonstrated in the great variety of subjects under study and discussed at the Aerospace Medical Assn. meeting, and by the growing trend to establish and expand the human factors capability in industry. Recruiting activity is now at its highest level for experienced life sciences researchers.

Majority of the reports delivered at the meeting were on research aspects of manned space flight, a marked difference over past meetings where clinical studies dominated.

Among the significant topics were:

- **Space magnetism** and the potential hazard of low-level magnetic fields on humans.
- **Requirement for more study** of the meteoroid hazard on spacecraft.
- **Description of a back-seat** bladder pilot restraint system which will allow the pilot to control a re-entry vehicle under high acceleration.
- **Effects of low pressure** on skin tissue unprotected by pressure suits.
- **Description of the Mach 3** escape capsule designed for the B-70.
- **Demonstration of an 800-lb.** spacecraft kitchen with enough food to sustain three men on a 14-day mission.
- **Recent experiments** in the study of radiation effects of space travel.
- **Medical electronics,** a rapidly growing field particularly in instrumentation for monitoring humans and animals on space missions.
- **Continuing studies in acceleration** loads and methods of increasing tolerance to g forces.

The Navy reported during the session that for the past two years, all air trainees have been given the opportunity to volunteer for astronaut training. Of 1,350 cadets, 330 volunteered and 24% of the volunteers scored as well as the seven Mercury astronauts in selection criteria abilities.

The Aerospace Medical Assn. invited Maj. Yuri Gagarin to the meeting, but the Soviet cosmonaut had not responded to the invitation late last week.

Dr. Dietrich E. Beischer of the Naval School of Aviation Medicine, Pensacola, Fla., reported on the biological effects of magnetic fields in which he concluded that data is too fragmentary to arrive at uncontradicted theories. He told AVIATION WEEK that biomagnetics should be observed in the same way as weightlessness, a condition largely unknown. There is a theory that man could live better and longer in magnetic fields stronger than the earth's 0.5 Gauss level. Absence or near-absence of magnetism could have an opposite detrimental effect.

Low fields are known to exist in interplanetary space, where intensities are about 10^{-5} Gauss, and on the surface of the moon, where the intensity is less than 10^{-3} Gauss. Mars and Venus fields are believed to be similar to that of earth, Jupiter is thought to have a strong field, and stars vary in intensities from 500 to 34,000 Gauss. Strength in a solar flare reaches 100 Gauss. In addition to planetary intensities, electric propulsion systems will be a source of exposure to high field strengths in manned flight, Dr. Beischer said.

Mice are the largest animals exposed so far to magnetic fields, and results have been contradictory. In one test, a mouse was exposed to 4,000 Gauss for four weeks and showed a tendency to retain a youthful appearance with an increased alertness. In another experiment, a group of seven-week-old mice died within 10 days when exposed to a field intensity of 5,000 Gauss. Third experiment using two generations of flies showed no deviation from normal except for faster movement in the field. Flies were observed from larvae to pupa to fly in two consecutive life cycles.

U-2 Pilot Equipment

Chicago—Strategic Air Command's 4080th Support Wing flew 6,048 U-2 missions in the three-year period ending last May, and the MC-3A partial pressure suit functioned normally on all 271 cabin decompressions experienced by U-2 pilots during this period.

Summary of aeromedical experience in the SAC U-2 weather research program covers 2,402 flights above 60,000 ft. for periods greater than 4.5 hr., and was given at the Aerospace Medical Assn. meeting last week by Capt. Robert J. Bruneau of Laughlin AFB, Tex.

Dr. Bruneau said there were 1,566 personal equipment problems during the period, 64 of which caused mission aborts. Majority of the problems were traced to excessive oxygen loss, suspected malfunctions in the sea kit and face plate fogging in the MA-2 helmet.

Medical problems numbered 104 during the three-year period, causing 49 mission aborts of which five were aborted after takeoff. Pilots experienced 17 cases of joint and abdominal pain which caused aborted missions.

Dr. Bruneau said U-2 pilots spend the day before each flight in mission planning and 90 min. before takeoff have pulse, temperature and weight recorded. Average weight loss for a long mission is four to six pounds. Pilot begins dressing 45 min. before takeoff, and breathes 100% oxygen 35-40 min. before he goes to his aircraft.

Man-in-Space Shielding Problem Increased by Solar Flare Hazard

By Philip J. Klass

Washington — Carbon and oxygen nuclei, released in large quantities during a solar flare, have sufficient energy to penetrate the skin of a satellite and are very effective in producing biological changes, further aggravating the shielding problem for a man in space during solar flares.

This finding, based on analysis of a nuclear emulsion block successfully retrieved from Discoverer XVII, following its exposure to a giant solar flare on Nov. 12, 1960, was reported here during the spring meeting of the American Physical Society by Dr. Herman Yagoda of the Air Force Cambridge Research Laboratories.

Radiochemical analysis of metal pieces of the Discoverer XVII recoverable capsule, compared with similar pieces recovered from Discoverer XVIII on Dec. 10, 1960, showed that the earlier vehicle's exposure to the solar flare had generated within the metal radioactive gaseous isotopes such as tritium (radioactive hydrogen) and argon. Iron from Discoverer XVII contained 500 times more tritium than would be expected from conventional galactic cosmic rays, Yagoda reported.

Recent studies suggest that the location of a solar flare on the sun determines how quickly its deadly radiation will reach the earth and therefore how quickly it might be necessary to recover a man from orbit when the unpredictable flares occur.

If the flare occurs near the middle of the solar disc, the radiation travels to the earth quite slowly. The most rapid transit occurs when the flare is located on that part of the sun which is about to be carried out of sight of the earth by the sun's rotation, Dr. K. G. McCracken of the Massachusetts Institute of Technology reported.

The transit time from sun to earth depends on whether the sun's magnetic field is directly linked to the earth. When there is a direct linkage, the charged radiation particles travel down the lines of magnetic force rapidly. When the flare occurs in the middle of the solar disc, the field does not provide direct linkage with the earth. Further data on the solar magnetic field was recently produced by Explorer X (AW Apr. 24, p. 29).

Confirmation of the theory that magnetic lines of force from the sun act as a magnetic bottle to trap radiation emitted during a flare was obtained during last November's large flare, it was reported in a study by Harold Carmichael and J. F. Steljes of Atomic Energy of Canada, Ltd. On Nov. 15, three days after the initial flare, another occurred which pumped additional radiation into the magnetic bottle at a time when the sun's lines of force directly linked the earth.

This caused the radiation particles to be accelerated to billion-electron volt energy levels and permitted detection of such radiation at sea level, which is very rare. The magnetic bottle concept also explains the sudden decrease in cosmic radiation that normally occurs soon after the start of a magnetic storm, called the Forbush decrease. As the sun pumps additional radiation into the space between its lines of force, the expanding magnetic bottle serves as a shield to exclude the steady-state cosmic radiation normally present in space. When the magnetic bottle envelops the earth, this steady-state cosmic radiation decreases for a day or more.

A new explanation of nature's fundamental particles, the proton and neutron, which agrees with the theory of quantum electrodynamics, was advanced by Prof. Robert Hofstadter of Stanford University.

Physicists recently have obtained experimental evidence that the proton and neutron are merely "two different aspects of a single entity—the nucleon" and not two separate particles, as previously thought. Hofstadter said that the only difference between the two is isotopic spin, which gives the proton a strong positive electric charge while the neutron has no charge at all. The latter is believed to contain equal quantities of positive and negative charge which cancel out, Hofstadter reported.

The new findings are the result of seven years effort which has been jointly sponsored by the Office of Naval Research, the Air Force, the Atomic Energy Commission and General Motors.

Scientists at the Boeing Scientific Research Laboratories, in their studies of plasmas, discovered that colliding beams of electrical particles explode, the company's J. E. Drummond reported. The experiment, conducted by Boeing's Dr. Melvin Kofoid, confirms an earlier theoretical prediction by Dr. Oscar Buneman of Cambridge University. "This Buneman-Kofoid 'blow-up' is a most dramatic phenomenon when seen and heard, via its radio emissions, in the laboratory," Drummond said. He said that it has "very serious implications in regard to the success of some thermonuclear [fusion-power] machines, such as the Astron of Dr. Nicholas Christofilos."

News Digest

American Airlines last week reported a net loss of $1.9 million for the first quarter of 1960, compared with a $453,000 loss in the same period last year. Carrier said flight engineers' strike in February was the principal reason for the loss.

Continental Airlines has reported net income of $164,000 for the first quarter of 1960. Gross revenues rose 11% during the period, while total operating expenses were held to a 9% increase.

Saab 105 twin-engine trainer and light transport aircraft is being developed with military and civil applications by the Swedish Saab Aircraft Co., Linkoping. The aircraft will be powered by two Turbomeca engines and a design model will be displayed at the Paris Air Show, May 26-June 4.

Twin-Boom twin-engine Cessna 336 Skymaster prototype has completed 38 hr. of flight evaluation and currently is being fitted with production-type engines and some minor modifications (AW Apr. 3, p. 19).

Kaman HU2K experimental prototype helicopter disintegrated at 92% rpm. during a tiedown test at 73F temperature in the climatic test hangar at Eglin AFB, Fla., slightly injuring a company test pilot and seriously injuring a Navy pilot.

NASA Wallops Station has fired a steel pellet into the atmosphere at about 25,000 mph. in a high speed reentry test, using a seven stage Trailblazer I solid fuel research vehicle. Pellet was fired from an explosive accelerator attached to the 5-in. spherical rocket sixth stage. Three Trailblazer stages were fired to carry the vehicle to an altitude of 175 mi., then four stages fired downward.

Sperry Phoenix Co. will equip pilotless B-47 jet bombers (QB-47 drones) with necessary radar command-guidance-telemetry systems for remotely controlled missions hundreds of miles off the Florida coast as part of Air Force tests of its SAGE system.

Explorer XI Launched

Washington—Eighty-two pound Explorer XI gamma ray telescope satellite was launched into orbit successfully Apr. 27 by National Aeronautics and Space Administration from Cape Canaveral, Fla., using a Juno II vehicle (AW Apr. 3, p. 29). Primary objectives were to detect and measure cosmic gamma radiation which cannot be accurately measured from within the earth's atmosphere.

Airlines Beginning to Probe Mass Market

Carriers will try to lure middle-income travelers from U. S. highways to bolster the lagging growth rate.

By Robert H. Cook

Washington—Middle-income wage earners will become the major sales target of airlines this year as the industry attempts to offset a faltering growth rate by luring more passengers from the expanding national highway system.

In the wake of last year's severe profit setback, several airline managements are exploring the perennial problem of how to divert more business from auto travel with renewed vigor and determination, spurred by intense airline competition, continually rising costs and a fear that the rapid expansion of the 41,000 mi. national highway system may further dilute the industry's already weakened growth rate.

Out of this industry concern has grown a variety of new low-cost air fares, many of them nearly directly competitive with auto travel costs and all of them designed to tap the vast reservoir of potential traffic represented by the middle-income wage earner.

Most of these new promotional fares are concentrated in the east, with three airlines offering special no-reservation, low-fare service on heavily traveled short haul routes, and three others now providing economical package plans for transportation between New York and Miami and Miami accommodations at an over-all price cheaper than rail or bus transportation and nearly equal to auto costs.

While these Florida fares are experimental, their success could mean a complete reshaping of the entire airline fare structure, many observers feel. As one airline executive put it, "we're now face to face with the problem of proving whether airline travel is primarily for the wealthy or whether it can be brought within the reach of lower income earners who pay a majority of this country's taxes.

"It seems we have been fighting over the same size traffic market every year, and I don't see the advantage or wisdom in sacrificing weak airlines to stronger airlines through mergers, when there should be enough business for all by reaching new markets instead of constantly catering to the expense account passenger."

Any hope for new fare increases to alleviate the industry's current financial ills appears extremely dim. The present Civil Aeronautics Board, under Chairman Alan S. Boyd, is extremely economy-minded and feels that many of the financial difficulties which the airlines blame on over-competition induced by the Board, can be traced to the carriers' insistence on fighting for a share of the same market they have served for years, instead of concentrating on methods of attracting new passengers.

Faced with steadily increasing operational costs, the industry may suffer a further financial setback if a full system of user charges is adopted to cover the cost of operating the federal airways system. A recent Senate transportation study estimates that these costs could range as high as $190 million a year, which could raise fares as much as 7-11%.

Noting the steady decline in first-class revenues, compared with the growing coach traffic which accounted for 49% of trunk business last year (see p. 26), Air Transport Assn. says it "doubts" the industry can stand another increase in first class fares.

Raising the trunklines' average load factor by attaining higher traffic volume, according to CAB Member Whitney Gillilland, would do much to offset the airlines' profit slump. Observing that the excess seat capacity provided by turbojet aircraft decreased the average load factor to 61.4% in 1959, he pointed out that a load factor increase of one point would earn the industry about $26 million a year in added operating revenues.

While railway and bus transportation growth rates continued to decline in 1960, the airline industry's growth rate of only 4% was far below its expected traffic increase of at least 12%. Industry spokesmen are quick to blame the decline in growth rate on overcompetition and excess turbojet seat capacity, but a great many concede that the growth rate could have been much higher if the industry had made a concerted effort to attract some of the growing volume of auto travelers who last year accounted for nearly 89% of total intercity travel.

Senate transportation study points out that in 1948, airlines accounted for 6 billion passenger miles while private auto travel totaled 300 billion. Last year, autos accounted for more than 700 billion passenger miles, compared with 20 billion for the airline industry.

In 1946, the airlines offered 7.5 million available seat miles, registered 5.9 million revenue passenger miles and had an average load factor of 78.7%. By 1959, the industry's average load factor was down to 60.6%, on the basis of 48 million available seat miles and 29 million revenue passenger miles.

The average length of vacation auto trips has been increasing at a steady rate to a point where the average tourist drove 2,150 mi. last year, and only 6% of all auto vacation trips were under 500 mi., according to the American Automobile Assn. An estimated 54% of these travelers drove more than 2,000 mi., compared with 46% in 1955.

Traveling costs for an auto trip are less than half of airline fares for the driver, and they can be further reduced by spreading them over any passengers carried. For this reason, many airlines are concerned that attempts to divert passengers from highway to air travel may be made more difficult by the current $33-billion expansion and improvement of the 41,000 mi. interstate highway system.

The impact this highway expansion program could have on the airlines' mass market approach can be judged by AAA estimates that better roads have encouraged vacationers to drive further, with 85% of all tourist travel now done by car. Present auto ownership is about 61 million, and AAA predicts it will reach 114 million by 1976.

As an example of how the present system of express and toll highways has affected auto travel in the short haul market, AAA points out that the average driving time today between New York and Washington is only 5 hr., compared with 7 hr. in 1951. Current bus schedules list the travel time as 4 hr. 15 min., with a fare of $7.

A 1958 survey by the University of Michigan indicates that among 1,500 people interviewed on their vacation plans, 86% intended to travel by auto and only 1% by air on trips under 500 mi.

In the 500-1,000-mi. range, 84% said they would travel by auto and 3% by air. Between 1,000 and 2,000 mi., 11% indicated air travel and 78% auto travel.

In earlier studies, the survey asked subjects why they planned to use auto

rather than airline transportation and was told that "only the rich travel by air." After studying questionnaire results, University of Michigan researchers came to the conclusion that most air travelers are of necessity high income earners, and that auto use appeared at its weakest whenever the subject being interviewed was "rich enough to afford common carriage."

Similar studies by other groups seem to bear out these findings and indicate that whatever fare savings the airline industry has offered in the past have gone primarily to the type of affluent business traveler who makes several flights a year, rather than reducing fares low enough to attract any new volume of "first riders."

"The mass middle-income market is yet to be tapped," the Port of New York Authority wrote after a year-long survey of 30,000 passengers in 1956. The median family income of all passengers interviewed, 75% of whom were in professional or managerial class, was then $11,400 a year, and 25% of the total group questioned made in excess of $23,000 a year.

Family plan ticket holders were cited as the "wealthiest" passengers by the survey, which pointed out that two thirds of these passengers were the wives of businessmen earning more than $20,000 a year and traveling at company expense.

In one of its first studies of the travel market, the University of Michigan found that the use of air travel is in direct relation to the income earner's wage scale. In a group of 100 people who took non-business trips, the 1955 study noted that only seven in the $4,000-6,000 pay bracket planned air trips, compared with 44 in the $10,000-plus pay category.

Analyzing 1959 figures, the University found that 47% of the air travelers studied that year had incomes of more than $10,000 a year, and 47.5% of the passengers making more than $15,000 a year took several flights a year, compared with only 5% of those in the $5,000-6,000 salary range.

It is against such a marketing background that carriers such as Eastern and Allegheny are formulating their low-fare programs on the premise that profits can be expanded with a lower revenue yield ticket by expanding the over-all traffic volume.

On the strength of strong public acceptance of its $11.81 no-reservation fare between Philadelphia and Pittsburgh, Allegheny was permitted to extend the low-cost, commuter-type service into the Philadelphia-Providence-Boston market. Trans World Airlines also matches the local service carrier's fare in the Pennsylvania market, but has not attempted to push the low-fare service.

Eastern Air Lines now provides similar service in the Boston-New York-Washington market area with flights every other hour at a cost of $12 from Boston to New York and $14 between New York and Washington.

In the eastern long haul market, National, Eastern and Northeast Airlines last week announced new "package vacations" to Miami, providing a round-trip, night coach air fare, motel accommodations for a week and airport limousine service, all for $86.30, plus tax, from Washington, D. C. or $93 and tax from New York.

National's round-trip low fare is only $66 compared with $139 for first class flights, and is also only about $4 higher than a round-trip bus fare for the 1,100-mi. distance between Washington and Miami. Scheduled flight time for the trip is 3 hr. 13 min. on Lockheed Electra aircraft.

Extensive savings, in time and money, which this type of fare can offer over auto travel are shown by AAA estimates of the average cost of a driving vacation. Assuming that two people drive about 300 mi. a day, AAA estimates daily travel costs at $29 for gas and oil, lodgings, meals and tips. On the basis of a three-day drive to Miami, the round-trip motor costs alone would total about $174 for two travelers.

Driving the distance in only two days, permitting a three-day stay in Miami for a week-long trip, would still require the tourists to spend a minimum of about $200. In contrast, the same two people using the airline's low cost fare would require no more than 7 hr. in round-trip transportation, and with the cost of daily meals added to the package vacation, would spend about $234.

In effect from the first week of May through the middle of December, these package air fares are a prime example of how the airlines and resort areas are intensifying their campaign to strengthen their off-season revenues by tapping a high volume traffic density of low individual revenue yield middle- and lower-income tourists.

Allegheny carried 51,670 passengers between Philadelphia and Pittsburgh, last year in direct competition with TWA, which carried 79,280. Since it began its low cost, no-reservation service on the route, the $11.81 fares are now nearly half of its monthly revenues for that segment. In the first month of operations, the reduced fare accounted for 665 of a total of 3,168 tickets sold.

In March of this year, this increased to 4,020 tickets sold from a total of 9,549. Figuring the extensive savings in indirect costs in the non-reservation service, the airline estimates that total revenues per seat mile for the service are 4.4 cents and expenses are 3.8 cents, leaving a profit of about 0.6 cents per seat mile.

With 52-seat Convair 540 equipment, the airline has been carrying a passenger mixture of about 67% first class fares to 33% no-reservation, but it estimates that if the lower fare service were to account for 40% of the aircraft capacity, Allegheny would still earn a net operating profit of $190,000 on the route this year.

The airline has also instituted a new 50% discount Family Fare Plan, applicable all day, all week. The discount was offered as a result of a company study indicating that lower fares and a less restricted program stimulate family plan travel.

Bonanza Airlines also has joined local service industry attempts to attract new passengers by offering a $26 round-trip excursion fare between Los Angeles and Las Vegas. Pointing out that current first class, round-trip fares on the route are about $42, the airline said it is trying to attract people now using surface transportation "in line with CAB's policy to encourage fare experiments."

Eastern Air Lines contends it has made a profit on its "all bus" $40 one-way fares between Pittsburgh and Miami. Inaugurated last October, the low-fare service was scheduled to expire in April, but Eastern has petitioned the CAB to extend plan through October.

Revenues which the airline earned on this route, along with the same service from St. Louis and Cleveland, "now meet all of the out-of-pocket costs," Eastern reports. Direct plane mile costs for the service on Lockheed 1049 Super Constellations were recorded at $1.40. A survey of 3,100 passengers who used the low-fare service revealed that 9% of them were "first riders," and 22% formerly made the Florida trip by auto. More than 38% of those questioned cited economy of the service as major reason for flying.

Denver-United Dispute

United Air Lines is reconsidering its voluntary agreement to pay increased landing fees at Denver's Stapleton Field and may hold the city to its current 25-year contract which runs through 1965. Continental Airlines, which has the same contract as United, has refused the increase. Other carriers at Denver had no contract and are paying the higher fees.

Old fees under the contracts were 3½ cents per 1,000 lb. Increased rates are 9.52 cents per 1,000 lb. of maximum gross takeoff weight. United President W. A. Patterson told the Denver Chamber of Commerce in a luncheon speech that United objected to an anticipated surplus from airport fees that might go for any city purpose. He added that United was re-evaluating retention of its flight training operations in Denver.

Atlantic Bookings Fall Behind Jet Capacity

By Glenn Garrison

New York—North Atlantic airlines, their seat capacities swollen by new jet fleets, face an uncertain prospect for the peak summer season as advance bookings fail to keep pace with the capacity increase.

While there are important exceptions, officials of many transatlantic carriers admit that the volume of early bookings is not greatly above last year's at this point—in some cases it is even lower.

But the carriers still believe chances are good that the traffic will materialize to fill a profitable percentage of their expanded seat capacities. They point out that the trend is toward later and later bookings on the part of transatlantic customers. They cite several reasons for this: a more casual attitude on the passenger's part about a European trip, which used to be a big occasion planned for a long time in advance; the passenger's awareness that there should be plenty of jet space available this summer and booking far ahead won't be necessary; a wait and see attitude about economic and political conditions which might affect the traveler's decision.

The airlines also say that current business is good and traffic so far is showing up to provide good loads.

During the first quarter of this year, International Air Transport Assn. carriers on the North Atlantic increased their capacity by 47% to 589,000 eastbound and westbound seats. Traffic rose about 29% to 293,675 passengers.

Capacity for the entire year 1961 may show a rise of about 45% to a total of some 3,940,000 seats. On the basis of various estimates by the carriers, traffic—if the business materializes—should rise by something like 33% over 1960, which would top the two-million mark for the first time with a total of about 2,320,000 passengers.

If these predictions are valid, load factor for the year would be about 58%, a decline from 64% last year. It seems almost certain that the tremendous increase in capacity will result in lower load factors to some degree. At worst, of course, load factors could plummet and reflect a painful excess of empty seats on the North Atlantic.

The first quarter increase in capacity and traffic, incidentally, was accomplished with an increase of only 4% in the number of scheduled flights (to a total of 6,079). Reason, of course, was the capacity of the big jets contrasted with that of the pistons they replaced. During the first quarter of 1960, Douglas DC-8 purchasers still were operating pistons because of the delivery delay. At the present time, every scheduled North Atlantic carrier except Iberia is operating jets, and that airline plans to begin service with DC-8s in July.

This summer's schedules mark the trend toward providing more and more service from North American gateways other than New York. Both frequencies and relative capacity offered are increasing, for example, from Chicago to Europe and from the West Coast to Europe via the polar route. There are more direct services from other gateways. Pan American, for example, will for the first time this year offer direct jet flights from Philadelphia to Europe, with the flights originating at Washington-Baltimore. British Overseas Airways Corp. will serve Washington-Baltimore (via New York). Trans-Canada Air Lines has scheduled a service from Cleveland to Europe via Toronto. There are new nonstop services from Boston, and increased service from Montreal.

A factor in the prospects of the foreign-flag transatlantic carriers this year is the publicity concerning the U. S. gold drain and imbalance of payments, with the resultant "buy U. S." exhortations. The effect of this is difficult to measure, but the foreign lines don't relish it, citing the sums they spend for U. S.-manufactured planes and equipment. A particular irritant was a letter sent last fall by the then U. S. Secretary of Commerce to a number of companies and government employe supervisors encouraging a "fly U. S." airline policy. One tangible result of this effort has been the drying up of U. S. government business as far as the foreign carriers are concerned.

Transatlantic carriers generally concede that new levels of the travel market must be tapped in future to fill the vast number of new seats, and that this market is linked to lower fares. But so far the feeling seems to be that new efforts along this line should begin with the off-season rather than the rich revenue-producing peak season, which helps pay the bills for the rest of the year. The 17-day excursion fare is considered a step in the right direction but by no means a definitive one. This plan is up for review this month.

Political conditions are considered by some officials to be a major factor in the season's prospects. The degree of cold war tensions developing, for example, from the Cuban situation is thought to be of great importance to travel decisions. On a more minor note, such events as the Eichmann trial in Israel have an effect on the business: in this case, helping El Al Israel Airline's traffic and causing Lufthansa German Airlines some concern (a Lufthansa official says: "Eichmann isn't selling any tickets for us, that's sure.")

Here are some individual airline circumstances this year, with some official predictions:

• **Pan American World Airways** expects a "record" peak season. According to Willis G. Lipscomb, vice president-traffic and sales: "Transatlantic travel is greater this year than it was in 1960 despite reduced business activity and a slackening in first class travel . . . Our sales plans are geared to a 22% increase for the whole year. Due to a change in booking habits (made closer to departure) advance booking statistics are not a good guide to summer travel at this time." Pan American will offer a total of 79 peak weekly flights, up from 58 flights, to Europe from New York, Boston, Philadelphia, Washington-Baltimore, Chicago, Detroit, San Francisco, Los Angeles, Portland and Seattle. The total does not count multiple stops as separate flights. Some 9,480 seats will be offered weekly at the peak, up from 6,833. Pan Am expects to carry 449,000 transatlantic passengers in 1961.

• **BOAC** will increase its North Atlantic capacity about 30%, offering in the peak season 17,112 weekly seats in both directions on Boeing 707-420s and Bristol Britannia turboprops. Weekly flights in both directions will total 138, of which 32 will be in Britannias. During the peak season last year, BOAC was phasing out its smaller Comet 4s and phasing in the 420s, but this season marks the first in which the larger planes will constitute the carrier's entire jet fleet on the run. BOAC in its Atlantic and Pacific services will be serving eight U. S. and two Canadian terminals: New York, Boston, Detroit, Chicago, Los Angeles, San Francisco, Honolulu, Washington-Baltimore, Montreal, and Toronto.

• **Trans World Airlines** experienced its big switch-over to jets last year, when capacity rose by 71% to 386,000 seats. Capacity for 1961 will increase about 10.5%. Weekly seats each way at the peak will total 5,674, of which 5,600 will be in the carrier's Boeing 707-320 jets. There will be 40 jet and one piston flight weekly at that point. The peak season weekly capacity increase will be 13.2%.

• **Air France** expects a 65% capacity increase this year to a total of 148,000 eastbound seats. Eastbound passenger total, the airline says, is expected to rise 58% to 92,000 passengers. Eastbound flights out of New York will total 27, with 3,410 seats in its Boeing 707-320

Per Cent Share of Total Transatlantic Passenger Traffic

IATA Carriers—Eastbound—Westbound
U. S. Gateways Including West Coast

Calendar Years

	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
PAA	25.3%	24.7%	23.4%	29.8%	28.8%	27.5%	28.2%	32.0%	32.0%	30.5%	26.4%	27.9%	24.0%
TWA	22.2	21.5	22.6	23.7	21.8	24.0	24.2	21.8	20.5	18.1	15.2	12.1	15.9
BOAC	8.8	7.6	12.1	16.4	16.1	11.4	9.5	8.8	8.5	9.4	11.4	13.7	12.3
KLM	5.9	7.0	8.7	10.0	9.6	8.6	8.6	8.0	8.1	8.5	7.4	7.7	7.6
SAS	6.9	8.0	7.5	7.4	7.2	9.8	9.1	7.9	7.2	8.6	9.8	8.5	7.9
Air France	8.0	8.7	8.1	7.3	8.1	7.6	8.4	7.8	8.5	8.9	8.6	8.2	8.2
Swissair	0.4	0.9	1.3	1.7	2.5	3.4	5.1	3.8	3.5	4.0	4.0	3.8	3.7
Sabena	1.9	2.4	2.8	2.5	3.2	4.3	3.7	3.9	3.5	4.5	5.5	4.0	4.6
Lufthansa	....	....	....	....	....	....	....	1.2	4.2	4.3	5.2	5.5	6.4
Alitalia	....	....	....	1.0	1.3	1.5	2.3	2.3	1.8	1.3	2.5	3.3	3.8
El Al	....	....	....	0.2	1.4	1.9	1.6	1.3	1.1	.9	1.8	2.1	1.7
Iberia	....	....	....	....	....	....	.3	1.3	1.1	.9	.9	.9	.6
Qantas	....	....	....	....	....	....	....	....	....	....	.5	.5	.7
Irish	....	....	....	....	....	....	....	....	....	....	.8	1.8	1.9
Air-India	....	....	....	....	....	....	....	....	....	....	....	....	.7
AOA	20.6	19.2	13.5	....	....	....	....	....	....	....	....	....	....

jets. Frequencies will be increased at Chicago, Los Angeles and Montreal, remain the same at Mexico City and Anchorage. A major sales target of Air France this season is special interest tours organized locally rather than on a national basis.

• **Scandinavian Airlines System** expects a 30% capacity increase for the year, with a 16% increase during the peak season alone. Weekly peak flights will drop from 34 in each direction to 27, with 3,564 seats. SAS's September capacity will be affected by the delay in delivery of its Convair 990 jets: some DC-8 capacity will be pulled off the North Atlantic two or three weeks earlier than desired to serve other routes which the 990 was supposed to take over.

• **KLM Royal Dutch Airlines** will offer 3,500 eastbound peak weekly seats from New York in DC-8 jet and DC-7C piston equipment. Capacity for the summer season will be up about 37%. For the entire year 1960, the airline's capacity totaled 184,000 transatlantic seats including Montreal flights.

The above carriers are ranked one through six respectively in terms of 1960 traffic volume on the North Atlantic. Two of the fastest-growing airlines on the North Atlantic, Lufthansa and Alitalia, have scheduled impressive capacities for 1961.

Lufthansa will offer 118,500 seats in each direction this year, an increase of 70.5%, and the airline predicts a 50% increase in traffic. Peak weekly seats will total 3,618 eastbound in 26 flights. This is a 100.4% increase over the peak 1960 offering. North American terminals are New York, San Francisco, Chicago and Montreal. Lufthansa will be operating both the Boeing 707-420 and the Boeing 720B turbofan on its North Atlantic runs, with the 720B flying between New York and Germany only. Configuration of the big jet is 20 first class, 132 economy; for the 720B, seats are 36 first class and 66 economy. Lufthansa crews are now training in the 720B in Tucson, Ariz., and the airplane is expected to go into service this month.

Alitalia estimates a 96% capacity increase for the year, with a 77% increase during the peak weeks. Last year's seats totaled 93,000. Flights will increase from 11 to 18 in each direction weekly. Alitalia says its bookings are well up, with a 30% increase at Apr. 10 for the period through Aug. 31. All eastbound flights originate at New York, but three flights also serve Montreal and three serve Boston. This is an increase of one flight at each of the two cities. A new Boston-Rome nonstop also has been scheduled, a flight that formerly stopped at Milan.

The remaining transatlantic carriers are listed alphabetically:

• **Air-India** goes from three to five peak weekly flights with its Boeing 707-420s. Last year's load factors were around 90% at the peak, when flights were scheduled on week-ends; the airline hopes for 80-82% this year over the peak season.

• **Canadian Pacific Airlines** will offer 1,025 seats to Europe weekly on its Vancouver-Edmonton-Amsterdam and Montreal-Lisbon-Madrid-Rome services. CPA expects its third turbofan-powered DC-8 this month, will offer three jet and two Britannia flights weekly on its polar route, up from three Britannia flights; and two jet and two Britannia flights on the Lisbon route, up from two Britannia flights.

• **El Al Israel** has been operating a single 707-420 leased from Varig, expects its own two 420s this month (it has optioned a third). This summer's peak week offering will be four jet flights at 144 seats each, and four Britannia flights at 91 seats each. Last summer El Al operated six Britannia schedules.

• **Iberia Air Lines of Spain** plans four weekly flights with turbofan DC-8s beginning July 1. Configuration will be 124 seats, up from 71 seats in Lockheed 1049G equipment which was operated last summer on four-a-week schedules.

• **Irish International Airlines** will offer 14 weekly round trips in Boeing 720 jet equipment, which has replaced leased Lockheed 1049H equipment on the run. Total capacity May through September of this year will be 24,000 seats, up 72% from 14,200 during the last similar period.

• **Qantas Empire Airways** of Australia will hold at two weekly round trips on its transatlantic segment. It will put retrofitted 707-120B turbofan jets on the run during the summer. Present equipment is the 707-120 powered by straight jet engines.

• **Sabena Belgian World Airways** will offer 32 flights in both directions with 4,600 seats, up from 28 flights with 4,350 seats in both directions. Jet equipment is the 707-320. Sabena's capacity is up about 50% and business is expected to increase about 41%.

• **Swissair** estimates a capacity for 1961 of 76,000 seats, up from 40,000 in 1960. Peak week eastbound seats will total 1,984, up from 1,080 last year. Total of 16 weekly DC-8 flights in each direction will be scheduled at the peak, up from nine last year. Swissair expects a traffic increase of at least 33% this season.

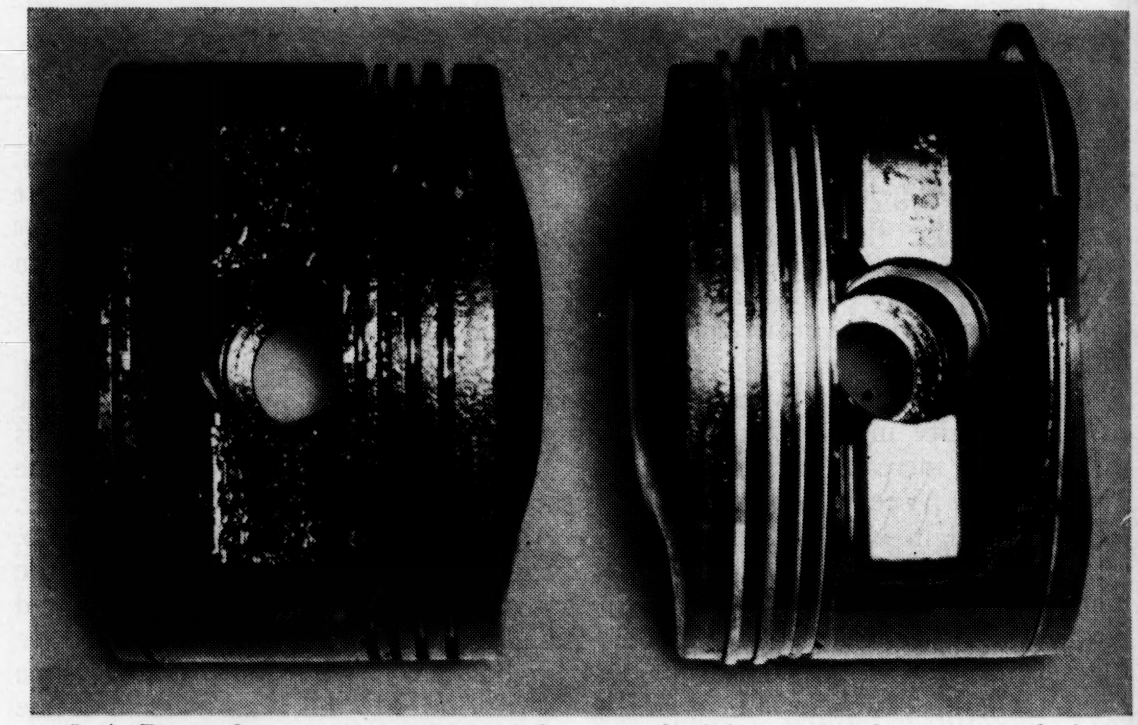
• **Trans-Canada Air Lines** plans to increase its transatlantic capacity from 124,021 seats in both directions to 184,875 seats during the entire year. Passenger total is expected to rise from 88,295 to 127,601. The airline has been operating turbofan-powered DC-8s since last summer on the route.

BULLETIN:

AeroShell Oil W becomes first non-ash additive oil to win approval of every aircraft engine manufacturer in the U.S.

Aircraft, large and small, have logged millions of flight hours on Shell's new additive oil—the first additive oil approved by every maker of aircraft engines in the United States.

Here are answers to 10 key questions about AeroShell® Oil W —how it helps keep engines cleaner, reduces wear—even extends periods between engine overhauls.



Left: Piston from engine using straight mineral oil after 1,000 hours; note sludge and coke. *Right:* Piston from same aircraft after 1,000 hours on AeroShell Oil W.

1. What types of aircraft can use AeroShell Oil W? Piston engine planes of any size. Helicopters, too.

2. Why is it called a non-ash dispersant oil? Because it contains special metal-free additives that help keep tiny, ingested particles in the oil from clumping together and forming deposits. These particles remain suspended and dispersed.

3. How does this affect engine performance? It means that engine parts stay cleaner. That lubrication points get all the oil they need. *Your engine can run more efficiently, parts can last longer.*

4. What about oil consumption? AeroShell Oil W helps provide a cleaner engine and decreased wear, you can expect less oil consumption.

5. Can AeroShell Oil W reduce maintenance costs? If you have been using a straight mineral oil, AeroShell Oil W can reduce your maintenance costs substantially. Intervals between engine overhauls can be extended. Because engines run cleaner with AeroShell Oil W, many users find that oil consumption is less.

6. How does this new oil respond from a cold start? AeroShell Oil W has an unusually high viscosity index. This guards against excessive thickening of the oil when cold, yet provides proper lubrication when hot. Result: *easier starting, faster warm-up.*

7. Is AeroShell Oil W thoroughly proved? Thoroughly. It's had millions of engine hours of flight time.

8. Can AeroShell Oil W be added as a make-up oil? Yes. It is compatible with all piston engine oils now being used.

9. Is there more than one viscosity grade? AeroShell Oil W is available in *three* viscosity grades: 100 and 120 grades for large engines. And 80 grade for small engines where straight mineral oil grade 55, 65, or 80 is normally recommended.

10. Where is it available? At Shell Aviation Dealers everywhere. *Any* dealer will stock AeroShell Oil W if you ask him.

Technical bulletin on AeroShell Oil W will be sent at your request. Write: Shell Oil Company, 50 West 50th St., New York 20, N. Y.

SHELL

A BULLETIN FROM SHELL
—where 1,997 scientists are helping to provide better products for industry

Monroney Bill Asks Airport Aid Extension

Washington—Amendment of federal aid-to-airports legislation calling for grants of $75 million a year for a five year period for landing aids and operating facilities was introduced last week by Sen. A. S. Mike Monroney (D.-Okla.).

The bipartisan bill, co-sponsored by 37 other senators, would extend the Federal Airport Act which will expire June 30.

Originally Sen. Monroney had planned a $400-million extension of the act, providing $100 million annually for four years, but he reduced the amount and extended the time limitations to conform with President Kennedy's budget.

Draft of the legislation was sent to Congress late last month by the President.

Sen. Monroney, who is chairman of the Senate aviation subcommittee, said he had obtained agreement from Federal Aviation Agency Administrator N. E. Halaby that considerations would be given to larger amounts if hearings on the bill proved that an increase would be warranted.

The bill will require that no project be approved for matching federal funds which does not include provisions for such landing aids as Halaby determines are required for safe and efficient operation.

Federal Aviation Agency submitted its National Airports Plan for 1961 to Congress last week.

It calls for the addition of 465 airports in the U.S., plus improvement of 2,834 existing airports to meet the nation's civil aviation needs over the next five years.

Total cost of the improvements projected in the plan is estimated by FAA at approximately $1.1 billion over the next five years.

Of this, about $900 million would be required for purchasing land, preparing the site and paving runways, taxiways and aprons.

Pan American Protests Court Stock Proposal

Pan American World Airways told a New York Federal Court last week that a court proposal to divest the airline of its 50% interest in Pan American Grace Airways would be more "penal than any penalties which could be imposed after a criminal conviction."

The airline was found guilty last March of violating anti-trust laws by restraining air commerce and was asked by the court to show why it should not divest itself of its interest in Panagra (AW Mar. 20, p. 41).

During last week's hearings, Pan American said that the only action which the court found improper was the carrier's refusal to allow Panagra to ask for extension of its routes to the United States.

"The conduct complained of can certainly be corrected without divesting Pan American from Panagra," Pan American said.

Airlines Scheduling Electra Without Limits

Washington – Modified Lockheed Electra turboprop aircraft are going into scheduled service at their originally certificated speeds—with new names—on four U.S. trunk airlines, and all trunkline Electras are expected to be operating without speed limits by the advent of summer.

The Electras' top speed was reduced from 324 kt. to 225 kt. in March, 1960, by Federal Aviation Agency after two accidents revealed the need for changes in the wings and engines nacelles. Lockheed Aircraft Co. has been modifying the turboprop transports to meet new Federal Aviation Agency requirements for operation at originally certificated speeds.

Six U.S. airlines using Electras are returning the modified aircraft to service without speed restrictions on this schedule and with these new designations:

- **Western Air Lines** has been scheduling its modified Electras without restrictions as soon as they began coming off the Lockheed line in February. Ten of the 12 aircraft Western ordered have been delivered. They are called the Electra II.
- **American Airlines** and Braniff Airways' modified Electra fleets were scheduled at the higher speeds Apr. 30. The aircraft will be called Electra II by both airlines.
- **Northwest Airlines** calls its modified Electras Lockheed Propjets. They also were scheduled to operate at original speeds Apr. 30.
- **Eastern Air Lines'** modified Electras are scheduled for unrestricted service late in July. They are called Super Electras.
- **National Airlines'** modified Electra transports are scheduled for service in July, they will be called the Super Electra II.

Seat Stress Standards

Chicago—Federal Aviation Agency will be asked to raise the g-loading standards of commercial aircraft seats to 20g compared with the 9g forward-aft load now specified.

Resolution on the standards was passed last week at the meeting of the Aerospace Medical Assn. Col. John P. Stapp of the USAF Aerospace Medical Center told Aviation Week that research in recent commercial aircraft crashes shows immediate requirements for stronger seat attachments and aft-facing seats because of the higher velocities to which today's aircraft would attain in a crash.

He said his studies indicate that the de-lethalization of seats—removal of hard or pointed surfaces from seat backs—has not prevented skull fractures and crushed legs because the passengers' bodies jackknife around the seat belts. Lateral load of 1.5g, up-down loads of 6g, and the 9g fore and aft loads required by FAA are insufficient, Stapp said. The human body and aircraft structure can withstand 50g, and Stapp said industry is capable of developing a lightweight (under 50 lb.) dual seat able to withstand 20g angular and lateral forces.

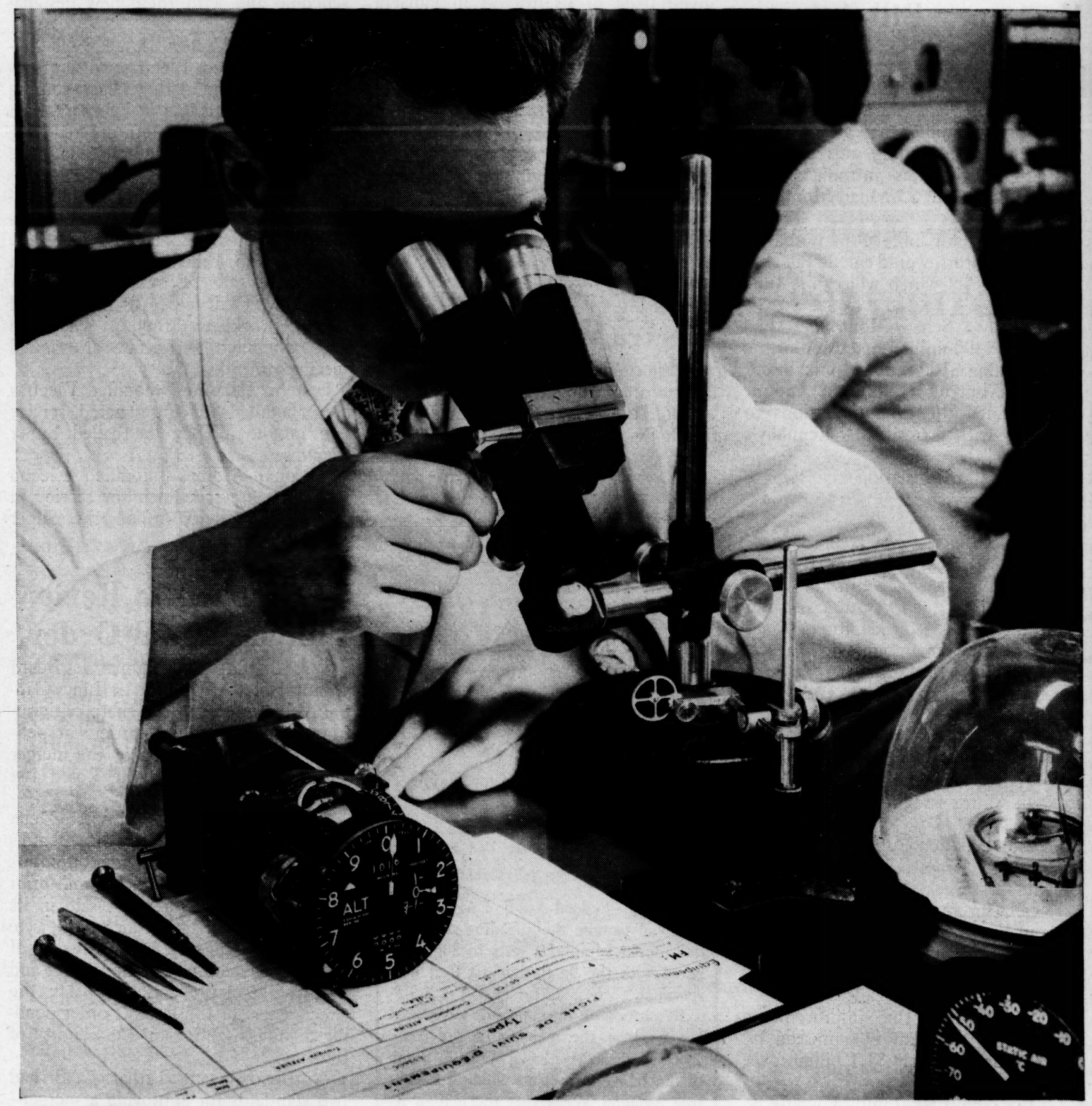
CAB Asked to Review United-Capital Order

Washington—Civil Aeronautics Board approval of the United Air Lines-Capital Airlines merger drew sharp criticism from three competing carriers in petitions for reconsideration of the merger which were filed with the Board last week.

The three airlines, Northwest, Delta and Eastern, challenged the Board's decision approving the merger on points of federal aviation policy, law and prior Board decisions. Northwest said in its petition that if reconsideration were denied, it would seek judicial review of the Board's decision on the merger and would take court action to stay the effectiveness of the Board's order pending a judicial ruling on the validity of the merger.

Northwest charged that CAB had two standards for approving a merger—one for normal route and merger proceedings and another for lines about to collapse.

The threat of Capital Airlines' bankruptcy—if the merger were denied—was made to seem a disaster, which coupled with the "self-serving ultimatums of United and Vickers" (Capital's mortgagee) forced the Board's approval of the merger, Northwest said. The merger, according to Northwest, violates the aims of the Federal Aviation Act by disregarding precedents set in earlier Board decisions which sought to encourage competition and narrow the gap between large and small trunklines, certificate regional carriers for regional routes and encourage competition rather than attempt to eliminate the competition.



Why Air France Jet parts never wear out

This technician is subjecting a gear from the altimeter of an Air France 707 Intercontinental Jet to microscopic study. It's being examined for signs of wear or oxidation . . . and this is just one of *fifty* separate tests given every Air France altimeter every 1000 hours of use!

What's more, *each* Air France jet part undergoes exhaustive inspection . . . and has a "life" of its own. Technically, this "life" is called the "potential"—a fixed period of time when it just can't wear out. In the case of the altimeter, for instance, the potential is 5,000 hours. Yet Air France inspection is continual throughout this time period, and long *before* the potential is reached, the part has been replaced by a new one!

Such attention to detail explains why 6,525 out of 22,200 employees, almost *one-third* of all Air France personnel, are engaged in maintenance. Skilled technicians working on a round-the-clock basis guarantee that every Air France flight will leave the ground in perfect working order. One more reason why Air France is the world's largest airline, with a forty-two year record of flying experience and service.

AIR FRANCE JET

World's Largest Airline/Public Relations Personnel Ready To Serve you In New York, Chicago, Los Angeles, Montreal, Mexico City

BEA Orders Three Argosy 650s For European Cargo Transport

London—British European Airways, responding to a need for fast delivery of bulky cargo to European terminals, has ordered three Armstrong Whitworth Argosy 650 turboprop freighters for delivery in November at an undisclosed price.

The new airplanes will supplement BEA's already extensive shipments of cargo in holds of its Vickers Vanguard, de Havilland Comet and Vickers Viscount passenger planes.

This cargo, of necessity, is in small packets but BEA says over-all results have been encouraging enough to expand equipment for the larger cargo field. For instance, in January (latest figures available) BEA carried 3,334 short tons of freight, up 7% over that month a year ago.

By comparison, British Overseas Airways Corp. hauled 953 short tons in January, but this was a 27% improvement over January, 1960. Last year BEA carried a total of 46,737 short tons of freight, a 20% improvement over the preceding year.

Addition of the three Argosy 650s does not mean that BEA is making a marked attempt to develop a new cargo service, spokesmen said. Instead, the airline is buying the equipment to round out what it calls a "complete freighter service" for the customer who needs air delivery of heavier items.

The 650s will be based at London (Heathrow) Airport and will be used in conjunction with BEA's Douglas DC-3s converted for cargo, stripped Viscount 812s and Avro Yorks leased from Dan-Air Services, Ltd.

BEA currently is studying possibilities of using the AW 650s on daylight flights to a number of European terminals. Most bulk freight shipped aboard the present all-cargo planes is transported at night for pickup by truck the following day. The airline hopes to eliminate this delay by scheduling runs which would be met by ground transportation for faster delivery.

Scheduled freight runs now connect London with Paris, Brussels, Nice, Milan, Rome, Duesseldorf, Frankfurt, Amsterdam and Copenhagen, on the continent, and Manchester-Glasgow and Manchester-Belfast in England.

One reason for selection of the AW 650, BEA noted, was the fact that the airline does its own overhaul of Rolls-Royce Dart engines at London Airport and "this means that the airplanes will fit nicely into the general maintenance schedule."

Another factor is that BEA was involved in design discussions with Armstrong Whitworth when the 650 first went on the drawing boards, although the company says not to the extent of its influence in eventual design of the Vickers Vanguard.

The three planes ordered by BEA will be fitted with a Rollamat quick-loading system specifically designed for the 650 by Armstrong Whitworth. Using this method, the manufacturer says the 650 can take aboard and unload 13½ tons of cargo in 12 min.

Airplane is fitted with light alloy rollers laid in strips on the fuselage floor. They connect with a movable bridge section which aligns with the truck bed sill. Pallets then are rolled aboard and secured by locking mechanisms. No elaborate ground handling system is needed, the company added. In all, the 650 will carry eight or nine pallets.

National Advertising Criticized by Board

Washington—Civil Aeronautics Board has ordered National Airlines to avoid "misleading and deceptive" language in the airline's "Fly and Drive" plan for Florida vacations.

Basis of the Board's cease and desist order against National was a complaint filed more than a year ago by Eastern Air Lines, which charged that a National advertisement created the public impression that Fly and Drive passengers would receive a complete two week vacation, including hotel accommodations, car rental and round-trip fare, for $70.20 plus tax.

Published one time in the New York Journal American, the advertisement contained an asterisk near the price, identifying the sum as the cost of round trip, night coach fare between New York and Miami on Monday, Tuesday or Wednesday. Eastern also complained that the fare quoted in the advertisement was represented as being the lowest offered in the New York-Miami market, although Eastern and Northeast both offer the same competitive rate.

Supporting recommendations made earlier by Examiner Curtis C. Henderson, the Board criticized the ambiguity of the advertisement and noted that while it was published only once, it "undoubtedly" reached "thousands" of prospective customers. Both the composition and publication of the advertisement "were not inadvertent, but were calculated acts" designed to give National a competitive advantage, the Board order stated.

CAB Cuts MATS' Rates

Civil Aeronautics Board has lowered the minimum rates Military Air Transport Service can pay certain airlines for carrying plane-load lots of cargo overseas. At the same time, CAB has indicated that the adjustment, effective May 1, may foreshadow further rate cuts in the future. **(See story p. 60.)**

The new rates apply primarily to supplemental and domestic cargo carriers, which must obtain CAB exemptions before flying charters to points not covered by their operating certificates. In actual practice, however, U. S. flag carriers usually respect such rates when bidding for MATS contracts.

The Board also opened the door for other rate reductions by allowing the same carriers to quote rates based on shorter great circle routes, rather than the routes actually flown. But CAB has not decided whether carriers operating short-range transports could bid on the basis of great circle routes that their aircraft could not actually fly.

Based on a "minimum revenue load standard" of 18 tons for both Lockheed Constellation and Douglas DC-7 aircraft, the new minimum rate for round-trip cargo services in these aircraft is 13.75 cents per ton mile. Old rate was 14.5 cents. When the carrier moves passengers in one direction and cargo in another, a new rate of 16.5 cents per ton mile replaces old rate of 19 cents.

Commenting on what action it would take if an airline demonstrated it could operate profitably at still lower rates, CAB said that consideration based on additional data might warrant further adjustment. But it added that the "Board does not generally base a rate for a group or class of service on the results of only one carrier."

Swissair Will Lease Two Convair 880Ms

Zurich—Convair Division of General Dynamics Corp. will deliver two 880M-22 jet transports to Swissair on a lease basis late this summer to fill the gap left by delivery delays of the longer-range 990.

The first 880 will arrive in Switzerland in August, the second in early September. They will be placed in service on Swissair's Far Eastern routes until the 990s begin operations early next year.

Details of the agreement, which will enable Swissair to match the jet competition of other Far Eastern carriers which it has had to face with Douglas DC-6 equipment for more than a year, were not announced.

TWA leads with Jets on time!

TWA's on-time Jet record is the best in the business. For over a year TWA has averaged decidedly better than its two transcontinental competitors, based on latest available data from the Civil Aeronautics Board. Seasoned Jet travelers know that TWA sets the Jet standard in the United States for on-time departure, on-time arrival... for schedule reliability. TWA is proud of its experienced team of Jet captains, flight and ground crews, maintenance men, meteorologists. Their skill made this extraordinary record possible. Next time you fly for business or pleasure, get there on time...aboard swift, dependable ***TWA SuperJets.***

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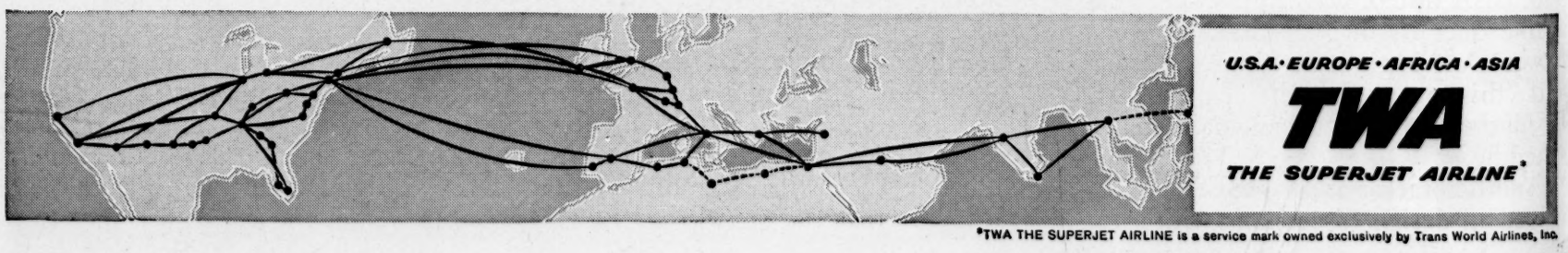


*TWA THE SUPERJET AIRLINE is a service mark owned exclusively by Trans World Airlines, Inc.

Airlines Measure Religious Tour Market

By Arnold Sherman

New York—Transatlantic carriers are taking a new hard look at the religious air travel market—a move largely precipitated by the high-seat capacity of the carriers' jet fleets.

Air France, playing down charters as "unrealistic, since a charter means that a religious group must generate enough interest to sell a full flight," is concentrating instead on religious tours available on a space-allocated basis. "In that way," an Air France spokesman maintains, "groups of 20-30 pilgrims can choose between a variety of flights and excursions."

The French carrier currently is conducting a market research program into the religious air market, analyzing the results of previous religious package tours and projecting these figures into a survey of potential business which, one Air France official said, "is frankly tremendous." Concurrently, the airline is engaged in an advertising program geared exclusively at the religious market. Over 60 newspapers and magazines with religious overtones carry Air France advertisements—reaching over 4 million subscribers and with a total readership estimated at nearly 16 million.

Air France maintains a special segment of its Tour Department geared to the religious market. Like most other transatlantic carriers which have undergone the transition from piston to jet equipment, the additional seat capacity and the expense of running turbine equipment has forced Air France management into a "reappraisal" of all aspects of the air transport market.

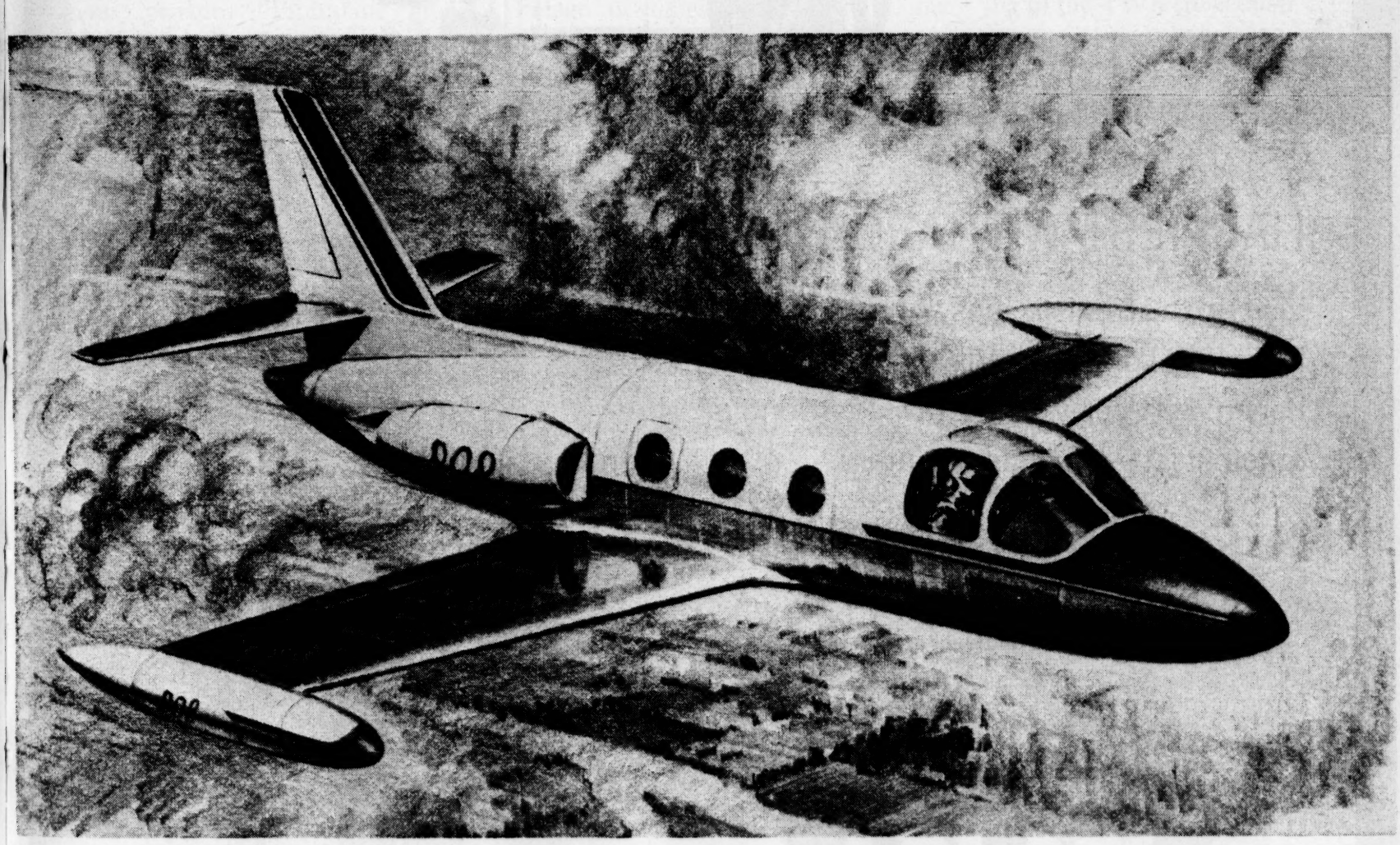
Tour Increase Seen

In 1960 Air France sold 62 religious tours. This year the airline already has booked 45 tours for the months of June and July and the prospects for appreciably exceeding last year's record "are excellent," an Air France spokesman said. Conservative Air France estimates are that religious tours will "increase at least 5%" although unofficial but less cautious estimates peg the figure considerably higher on the basis of figures already available to the French airline.

Religious tour interest, according to Air France, is ubiquitous. Groups of pilgrims have gathered from every corner of the United States and Canada. The added religious incentive to travel is probably attributable to a combination of factors. Organized religion is on the ascent throughout the country, the traveling appetite of the nation has been aroused and jet equipment lends itself to comfortable, fast transportation.

For the most part, a religious tour begins in a parish or congregation. A group of people find themselves interested enough in visiting shrines or religious sites to justify the trip and under the guidance of their religious leader contact the airline. If enough of the congregation is interested then a charter is in order. More likely a religious tour is either selected or arranged. Nor does this preclude individual travel with a predominantly religious motive. The number of people traveling for spiritual reasons outside the organized tour program probably outdistances the tours themselves.

Under Air France's current religious program, an exclusively Moslem tour is



Preliminary Design of Piaggio-Douglas PD-808 Executive Jet

Artist's conception of Piaggio-Douglas PD-808 (AW April 17, p. 39) shows preliminary configuration of light jet business transport which is to make its first flight in 1962. Preliminary design of the six-passenger, twin-engine aircraft is not yet complete at the El Segundo Division of Douglas Aircraft Co. Detail engineering and production is to be done by Piaggio of Genoa, Italy. Douglas has an option on exclusive sales and service rights outside Italy and a few other European countries. The U. S. company also has manufacturing rights to any orders for the airplane placed by the U. S. government and can produce the airplane for commercial customers after Piaggio has sold a specified number. The Italian air force has shown interest in the airplane and is helping to finance its development. The PD-808 will be designed to cruise at 500 mph. and 40,000 ft. with a cabin pressure equivalent to 7,500 ft. altitude.

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Visit up to 18 extra cities at no extra fare, including London, Paris, Rome, Copenhagen. Service by SAS Caravelle—world's quietest jet—to all main centers.

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being prepared, as are tours for religious Jews bent on visiting Israel. "There is considerable Protestant interest," according to Air France, in visiting Israel. By far, however, the Catholic-oriented program overshadows the rest. Among the tours planned under the aegis of Roman Catholic clergymen are:

• **Easter tours** to Jerusalem, Nazareth, Galilee and Rome.

• **Fatima pilgrimages**, including stopovers at Lisbon, Lourdes, Madrid, the Benedictine monastery of Montserrat outside Barcelona, and Rome.

• **Around-the-world** pilgrimages, highlighting a Passion Play performance at Erl in Austrian Tyrol.

• **Extension trips** from Paris to London shrines, Dublin, Killarney and Cork.

• **Trips to Innsbruck**, Oberammergau, Munich and Assisi.

Interested as it is in the religious market, Air France holds no monopoly in this area. Most of the major transatlantic carriers are eyeing their religious tour programs with renewed interest.

• **KLM Royal Dutch Airlines,** in conjunction with the Catholic Travel Office, Washington, D. C., is scheduling four pilgrimages this summer to European shrines and the Holy Land. Milton Holtz, KLM regional tour manager, said that mounting interest is prompting a more vigorous approach to the religious market. "Protestant group travel is increasing tremendously," he said. "Methodists are oriented to England and Scotland while the Lutherans show an obvious preference for Germany. Jewish travel to Israel has risen phenomenally although no one knows exactly how much of that travel is purely religious." Holtz cited the following as cogent reasons for religious group travel: Travelers (in groups varying from a minimum of 15 to an occasional figure near 100) share the same backgrounds and interests. Spiritual directors accompanying the pilgrims are better qualified to point out religious significance of shrines and religious sites. Prayer meetings can be conducted en route. Normal group travel incentives, such as bus and hotel discounts, prevail.

• **Lufthansa German Airlines** attributes its "phenomenal 1960 religious-oriented travel to the Passion Play performance at Oberammergau, Germany, and the Eucharistic Congress in Rome." Considerable advertising is gaged at the religious market and Lufthansa's sales force is active on "the parish level." Total religious travel is "small but significant."

• **Scandinavian Airlines System's** religious program includes a special Vatican representative for arranging audiences with the Pope, facilities for assisting and coordinating the programs of pilgrims touring Rome, portable altars at key airports. Working in conjunction with the Israel-American Institute for Biblical Studies, a tour including classroom activities in the Holy Land is planned. A Moslem-oriented religious tour leaving New York May 14, and keyed to visits to Mecca and Medina, is being arranged. The airline is quick to emphasize, however, "that total traffic from this [religious] market is small compared with over-all passengers carried."

• **El Al Israel Airlines,** working in conjunction with the Jewish Agency, a quasi-official adjunct of the Israeli government in the United States, is investigating the possibility of organizing Bar Mitzvah tours to Israel. The agency would offer an opportunity for youngsters reaching the age of 13 to celebrate their confirmation in the Holy Land, accompanied by their parents.

• **Sabena Belgian World Airlines** spokesmen claim that "the [religious] market is huge and our sales and executive personnel are aware of its present significance and potential." Sabena maintains direct flights to Lourdes, France, and keys its religious-oriented air program to annual religious activities. "Lourdes and tours to Israel are our two largest pilgrim attractions but during the Passion Play performances at Oberammergau we did considerable business in that direction."

• **Irish Airlines,** according to one of its officials, "carries perhaps a higher percentage of religious traffic than any other." There is a large-scale movement of priests, nuns, and church officials, and the airline relies heavily on religious motivation as a source of traffic revenue.

Among U. S. carriers:

• **Trans World Airlines'** recent meeting of vice presidents and sales personnel highlighted the carrier's continued interest in the religious market as a means of bolstering winter tourist traffic. A TWA spokesman said "it has been the policy of the company to promote religious travel for a number of years through such organizations as the Catholic Travel Office and the American Express. Now with jets making available more passenger seats than ever, management is taking a fresh, direct look at the market potential." The airline's big effort is going into its St. Patrick's Centennial Celebration in June—this correlating with TWA's initiation of two jet flights a week into Shannon, Ireland, started Apr. 30. "More passengers display a religious incentive, more people call for information on religious tour programs and the net result from where we're sitting," according to the TWA spokesman, "is a much broader market than we realized."

• **Pan American World Airways,** while transporting pilgrims as in the past, plans no new impetus to its program and feels that religious-motivated travel represents only a relatively minor aspect of its over-all operation.

From today's vantage point, it seems unlikely that the religious market will represent a significant aspect of the over-all transatlantic market, yet it is becoming increasingly evident that the religious-oriented traveler is gaining in stature and number and most airlines are preparing to accommodate him.

Percent Scheduled Aircraft Miles Completed 1960-1959

	1960	1959	Change
American	97.3	98.1	− .9
Braniff	98	98.6	− .6
Capital	95.8	96	− .3
Continental	97.5	97.9	− .4
Delta	97	96.8	.2
Eastern	95.2	97.3	−2.2
National	92.8	93	− .3
Northeast	92.5	90.3	2.4
Northwest	97.3	97.1	.2
TWA	98.4	99	− .6
United	97.4	97.9	− .5
Western	98.5	99	− .5
Total	96.8	97.4	− .6

Trunkline Carriers' Passenger Load Factors 1960-1959

	First-Class		Coach		Total	
	1960	1959	1960	1959	1960	1959
American	61	67.8	71.4	75.1	65.2	70.4
Braniff	55.2	56.9	60.1	65.1	56.7	58.1
Capital	55.7	59.5	45.9	54	53	58.4
Continental	47.7	51.8	53.7	61.4	50.3	54.8
Delta	58	58.3	61.1	55.5	59.3	57.1
Eastern	50.1	48.6	54.2	52.8	52.1	50.7
National	45.4	50.8	61.4	61	53.7	55.3
Northeast	56.9	55.1	47.3	47	51.5	50.3
Northwest	50.2	52.2	59.1	58.6	55	55.6
TWA	57.9	66.8	69.2	74.1	63.9	70.5
United	59.2	63.1	70.4	70.9	64.7	66.4
Western	55.6	58	60.8	64	57.8	60.2
Total trunklines	56.1	59.5	63.4	64.2	59.5	61.4

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A scant year ago, the sight of an AIR-INDIA plane at New York's International airport might well have provoked the query, "AIR-WHO?" or even "AIR-WHAT?" Today, 355 million world-wide passenger miles later, over 16,000 transatlantic maharajahs have enjoyed the delights of AIR-INDIA's potentate-pampering service. Now we've expanded our schedule to five flights a week from New York to London, Paris, Geneva, Frankfurt, Prague, Rome and the East. And now more travelers than ever can enjoy the warmth of lavish Eastern hospitality . . . the solicitude of charming sari-clad hostesses . . . and the comfortable surety of Boeing 707 Rolls-Royce Jets, piloted by veterans of AIR-INDIA's 14 years of world-wide service.

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Dollars Per Total Aircraft Hour

	FLYING OPERATIONS					DIRECT MAINTENANCE				FLYING OPERATIONS AND DIRECT MAINTENANCE	DEPRECIATION AND RENTALS	TOTAL DIRECT EXPENSE
	CREW EXPENSES	FUEL, OIL & TAXES	INSURANCE	OTHER EXPENSES	TOTAL	AIRFRAMES	ENGINES	OTHER FLIGHT EQUIPMENT	TOTAL			
707'S												
AMERICAN	112.76	225.95	36.44	0.56	375.71	65.64	86.80	12.01	164.45	540.16	120.64	660.80
BRANIFF	92.55	261.95	110.66	0.50	465.66	89.47	144.91	9.81	244.19	709.85	202.59	912.44
CONTINENTAL	93.21	237.20	61.58	0.06	392.05	45.34	97.13	9.81	152.28	544.33	120.13	664.46
NATIONAL	98.24	255.79	84.98	143.26	582.27	.....	.....	.....	.....	582.27	824.76	1,407.03
NORTHEAST	223.71	.....	155.35	0.09	379.15	.....	.....	.....	.....	379.15	1,458.36	1,837.51
TWA-100 SERIES	122.55	217.81	38.40	0.73	379.49	75.45	131.50	10.91	217.86	597.35	317.88	915.23
TWA-300 SERIES	153.02	245.76	47.45	0.53	446.76	63.89	106.44	6.38	176.71	623.47	258.30	881.77
PAN AM—100 SERIES	173.77	313.55	42.57	2.55	532.44	87.08	85.36	56.77	229.21	761.65	322.32	1,083.97
PAN AM—300 SERIES	187.28	325.66	67.71	(0.03)	580.62	56.12	65.66	47.82	169.60	750.22	248.44	998.66
WESTERN	99.69	219.01	90.52	.....	409.22	39.28	150.62	4.39	194.29	603.51	404.88	1,008.39
DC-8'S												
DELTA	88.60	244.03	81.30	0.15	414.08	97.98	124.99	3.27	226.24	640.32	236.09	876.41
EASTERN	102.47	228.41	90.03	0.05	420.96	58.78	76.52	9.23	144.53	565.49	238.59	804.08
NATIONAL	86.60	233.55	86.45	3.52	410.12	64.59	92.56	8.01	165.16	575.28	216.82	792.10
NORTHWEST	176.04	348.54	190.78	1.18	716.54	68.43	95.41	14.62	178.46	895.00	701.80	1,596.80
PANAGRA	132.95	314.40	156.41	8.04	611.80	293.82	75.05	13.99	382.86	994.66	308.49	1,303.15
PAN AM	196.13	274.70	94.41	0.76	566.00	68.08	58.85	39.41	166.34	732.34	279.30	1,011.64
UNITED	110.76	249.36	55.29	1.19	416.60	64.69	74.12	19.37	158.18	574.78	188.13	762.91
720'S												
AMERICAN	110.84	235.81	52.07	1.08	399.80	40.96	18.73	1.21	60.90	460.70	163.10	623.80
UNITED	76.43	187.35	37.11	2.30	303.19	33.48	37.15	21.66	92.29	395.48	171.70	567.18
880'S												
DELTA	102.83	222.07	98.13	.....	423.03	58.18	70.90	2.35	131.43	554.46	215.21	769.67
NORTHEAST	252.97	227.48	62.42	0.12	542.99	148.69	113.69	19.86	282.24	825.23	219.61	1,044.84
ELECTRA'S												
AMERICAN	92.70	70.73	10.17	0.44	174.04	41.68	115.62	16.45	173.75	347.79	164.01	511.80
BRANIFF	77.75	66.13	20.58	0.46	164.92	40.12	113.95	14.17	168.24	333.16	108.73	441.89
EASTERN	91.10	71.38	17.56	0.06	180.10	24.59	61.14	13.31	99.04	279.14	130.36	409.50
NATIONAL	78.55	71.37	26.42	0.02	176.36	28.33	98.72	11.78	138.83	315.19	123.61	438.80
NORTHWEST	83.77	73.69	22.48	0.95	180.89	30.08	70.12	15.94	116.14	297.03	92.19	389.22
WESTERN	73.32	71.52	20.88	.....	165.72	26.75	123.44	10.39	160.58	326.30	134.72	461.02
VISCOUNTS												
CAPITAL	58.59	53.92	6.62	0.01	119.14	25.46	21.75	4.60	51.81	170.95	47.58	218.53
CONTINENTAL	56.11	59.14	8.32	.....	123.57	29.02	25.73	5.54	60.29	183.86	52.26	236.12
NORTHEAST	48.71	53.72	13.05	0.05	115.53	32.58	23.10	9.56	65.24	180.77	58.18	238.95
SEABOARD	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,924.33	1,924.33
ELAND CONVAIR												
ALLEGHENY (Yr. End. 9-30-60)	49.41	48.03	20.61	0.63	118.68	12.31	65.49	3.21	81.01	199.69	43.76	243.45
F-27'S												
ALOHA	35.31	44.13	14.56	(0.02)	93.98	21.73	24.02	6.45	52.20	146.18	39.12	185.30
BONANZA	40.86	33.11	12.44	0.19	86.60	34.06	16.02	7.52	57.60	144.20	22.70	166.90
CONSOLIDATED	50.79	63.27	23.17	0.94	138.17	.....	.....	.....	77.08	215.25	35.12	250.37
OZARK	41.38	32.13	14.03	0.08	87.62	43.53	23.59	7.20	74.32	161.94	25.59	187.53
PACIFIC	42.66	30.48	13.88	1.69	88.71	27.16	29.82	17.53	74.51	163.22	29.50	192.72
PIEDMONT	47.71	33.34	11.65	0.01	92.71	37.06	23.42	8.11	68.59	161.30	24.33	185.63
WEST COAST	43.11	35.22	9.41	0.01	87.75	32.35	23.53	6.79	62.67	150.42	16.67	167.09
WIEN	52.27	66.81	45.06	0.67	164.81	.....	.....	.....	110.80	275.61	46.26	321.87

Turbine-Powered Aircraft 1960 Operating Expense

(Data supplied by Ray & Ray, Washington, D.C.)

Averages By Types Cents Per Available Ton Mile

TYPE	Flying Operations	Direct Maintenance	Depreciation and Rentals	Total Direct Expense
707's	5.80	2.32	3.03	11.15
DC-8's	6.71	2.55	3.34	12.60
720's	6.33	1.47	3.10	10.90
880's	8.63	2.75	4.36	15.74
ELECTRAS	6.55	4.98	4.99	16.52
VISCOUNTS	9.61	4.39	3.98	17.98
ELAND CONVAIR	8.98	6.13	3.31	18.42
F-27's	13.07	9.23	3.64	25.94

Cents Per Revenue Aircraft Mile

	Flying Operations	Direct Maintenance	Sub-Total	Depreciation and Rentals	Total Direct Expense
707's					
American	82.21	35.98	118.19	26.40	144.59
Braniff	100.83	52.88	153.71	43.87	197.58
Continental	84.12	32.67	116.79	25.78	142.57
National	127.54	.....	127.54	180.66	308.20
Northeast	81.83	.....	81.83	314.76	396.59
TWA—100 Series	81.45	46.76	128.21	68.22	196.43
TWA—300 Series	91.46	36.17	127.63	52.88	180.51
Pan AM—100 Series	121.13	52.15	173.28	73.33	246.61
Pan AM—300 Series	119.08	34.78	153.86	50.95	204.81
Western	108.99	51.75	160.74	107.83	268.57
DC-8's					
Delta	99.46	54.34	153.80	56.71	210.51
Eastern	102.45	35.17	137.62	58.06	195.68
National	93.54	37.67	131.21	49.45	180.66
Northwest	146.60	36.51	183.11	143.59	326.70
Panagra	134.75	84.33	219.08	67.94	287.02
Pan AM	132.19	38.84	171.03	65.23	236.26
United	93.03	35.33	128.36	42.01	170.37
720's					
American	90.98	13.86	104.84	37.11	141.95
United	88.97	27.08	116.05	50.38	166.43
880's					
Delta	91.75	28.50	120.25	46.68	166.93
Northeast	131.01	68.10	199.11	52.99	252.10
ELECTRAS					
American	61.55	61.45	123.00	58.00	181.00
Braniff	58.41	59.58	117.99	38.50	156.49
Eastern	65.83	36.20	102.03	47.65	149.68
National	63.06	49.64	112.70	44.20	156.90
Northwest	58.51	37.57	96.08	29.82	125.90
Western	55.62	53.89	109.51	45.22	154.73
VISCOUNTS					
Capital	49.88	21.69	71.57	19.92	91.49
Continental	47.81	23.33	71.14	20.22	91.36
Northeast	52.73	29.78	82.51	26.55	109.06
Seaboard	.....	.....	.....	1,339.44	1,339.44
ELAND CONVAIR					
Allegheny (Yr. End. 9-30-60)	51.62	35.24	86.86	19.04	105.90
F-27's					
Aloha	49.51	27.50	77.01	20.61	97.62
Bonanza	42.46	28.24	70.70	11.13	81.83
Consolidated	66.01	36.82	102.83	16.78	119.61
Ozark	46.18	39.17	85.35	13.48	98.83
Pacific	45.31	38.06	83.37	15.07	98.44
Piedmont	49.61	36.70	86.31	13.02	99.33
West Coast	46.34	33.09	79.43	8.80	88.23
Wien	71.12	47.81	118.93	19.96	138.89

AIRLINE OBSERVER

▶ Question whether Alitalia, the Italian airline, will be granted Los Angeles rights hinges entirely on whether Italy will agree to exchange traffic statistics with the U. S., a condition also proposed to the Dutch in their bid for West Coast rights (AW Apr. 24, p. 38). Italians originally agreed to the exchange, later revised this decision. Chances are strong that Alitalia will now accept this condition in order to get the Los Angeles traffic rights.

▶ **Watch for a move toward diversification outside aviation fields by at least one local service airline as a means of bolstering revenues to cut subsidy needs.**

▶ Convair 990 transport No. 1, with revised engine pylons, has flown five consecutive days at speeds up to its operational limit of Mach 0.91 without any recurrence of the oscillations which required the pylon fix.

▶ **Lockheed predicts that commercial versions of its C-141 turbofan freighter can carry cargo at direct operating costs of about four cents per ton mile, depending on stage lengths and load factors. Comparable costs for Douglas DC-6A equipment are now about 11-12 cents. First military C-141 is scheduled to become operational in late 1964 or early 1965 (AW Mar. 20, p. 24).**

▶ Look for accelerated interest in mergers within the local service airline industry. Currently, both North Central and Allegheny are actively seeking merger partners.

▶ **Post Office Department realized a net profit of about $10 million in the current fiscal year on air mail operations. Post Office profit compares with $1.8 million net earnings for U. S. trunklines in 1960 (AW Apr. 17, p. 40).**

▶ Aeroflot is becoming increasingly cost conscious in its attitude toward flight schedules as additional high capacity turbine-powered transports go into service. The Russian airline has always been casual about schedules, compared with western carriers. However, the organization is now calling for better weather briefings to reduce flight delays and cancellations and for improved ground service handling and facilities to cut late departures.

▶ **Boeing Airplane Co. has selected Sperry Gyroscope to provide high-reliability automatic control system for its 727 three-jet transport, following a competition among major autopilot manufacturers. Collins Radio reportedly was runner-up in the competition.**

▶ Supplemental airlines have asked the Civil Aeronautics Board to set minimum rate standards for transatlantic charter operations in protest against a Flying Tiger Line proposal to sell group charters to Europeans flying to the U. S. and return at rate as low as $99 per person. Independent Airline Assn. claims the Flying Tiger rate will spell "economic disaster" for the supplemental carriers.

▶ **Civil Aeronautics Board is considering an increase in baggage allowance for women, and has asked domestic airlines for comments on the proposal. Chances are strong that questions of reasonableness and discrimination will block the move.**

▶ International Federation of Air Line Pilots Associations has complained to Trans-Canada Air Lines, Canadian Department of Transport and the U. S. Federal Aviation Agency over operation of the Vickers Vanguard turboprop transport with a crew of two pilots. C. N. Sayen, the group's president, called for a third crew member as required by U. S. federal regulations. He said the two-pilot crew is inconsistent with the "practice of major air carriers of the world."

▶ **Aeroflot put its Tu-114 170-passenger turboprop transport into scheduled service last week. Initial service will be conducted twice weekly on the Moscow-Khabarovsk route.**

▶ Air France is operating its Lockheed 1049H all-cargo transports on the New York-Paris route with a cargo capacity of 33,000 lb.

SHORTLINES

▶ **Aeroflot,** the Russian airline, is using television screens at Moscow's Vnukovo and Sheremetyevo airports to provide latest flight information.

▶ **Aerovias Sud Americana** has Civil Aeronautics Board permission to conduct talks with various Central and South American cargo carriers concerning stabilization of cargo rates in the Caribbean area.

▶ **American Airlines** reports a load factor of 80% for its Boeing 720 turbofan aircraft during their first month of operation on the New York-Los Angeles route. Load factor for American's Boeing 707s for the same period and route was 66%.

▶ **British West Indian Airways** will begin Boeing 707 service from New York to Barbados and Trinidad on June 10. The weekly flights will leave New York on Saturday and return on Sunday.

▶ **Continental Airlines** will begin operating three round trips a day between Houston and Los Angeles with Boeing 707s on June 11, initiating service on the new route awarded in the Southern Transcontinental Case.

▶ **Delta Air Lines** has been awarded a 200 hr. time between overhaul (TBO) increase to 1,200 hr. on the General Electric CJ805 turbojet engine, powerplant for the carrier's Convair 880 fleet.

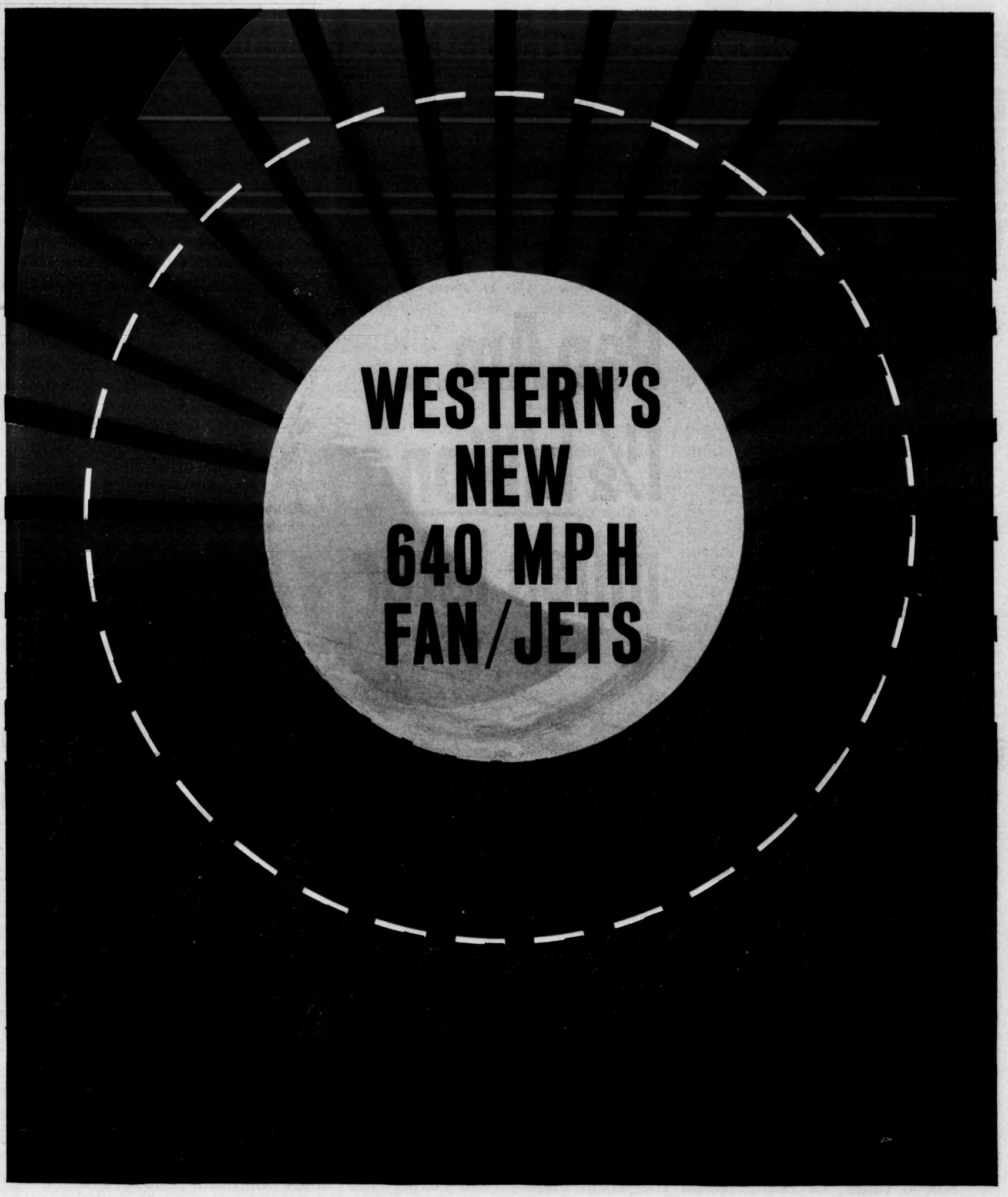
▶ **Japan Air Lines'** temporary authority to operate flights over its Tokyo-Okinawa-Hong Kong route on to Bangkok and Singapore has been extended one year by Civil Aeronautics Board—provided that no passengers bound for or originating at points beyond Hong Kong load or unload at Okinawa, an island under U. S. control.

▶ **North Central Airlines** will begin service on May 1, to Regina, Saskatchewan, Canada with one round trip a day terminating in Minneapolis/St. Paul.

▶ **Northwest Airlines** has ordered six Boeing 720B turbojet transports with options on six more. Delivery is to begin June and be completed October.

▶ **Pan American World Airways** has begun a low fare turbojet service from New York to San Juan, Puerto Rico at $55 each way.

▶ **Piedmont Aviation, Inc.,** has declared a 10% stock dividend, the first in its history. The dividend is reported as the third ever paid by a local service airline.



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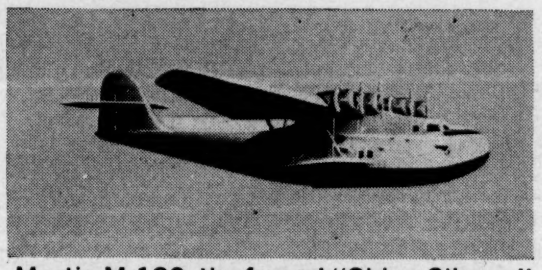
WESTERN
AIRLINES

PROGRESS REPORT ON THE WORLD'S MOST EXPERIENCED AIRLINE

Fokker F-7, Pan American's first plane



Martin M-130, the famed "China Clipper"

Douglas DC-3, noted for its reliability

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Fourth N.Y. Airline Airport Disputed

By Glenn Garrison

New York—Despite the Port of New York Authority's campaign, this region will not need another airline airport by 1965, according to a recent study by United Research, Inc.

The lengthy report, which includes national and regional traffic forecasts and discussion of STOL-VTOL operations, was made for Harding Township, a New Jersey community which lies in the area the Port Authority cited in late 1959 as the only possible location for a fourth airline airport to serve the New York-New Jersey area.

The Port Authority's so-called "preliminary" 1959 report stirred up fierce political resistance and controversy among communities in the area. A "definitive" report by the agency was supposed to follow in about six months, but has not yet appeared. Most recent projected date for its completion is some time next month.

The Port Authority had found that the need for a fourth airline airport would become acute by 1965, when La Guardia, Newark and New York International's peak-hour capacities would be saturated.

Its preliminary study indicated a proposal for a $220-million jet field in Morris County, N. J. (AW Dec. 21, 1959, p. 30).

Research Conclusions

But the United Research study, which gives more weight to the possible use of city center to city center STOL-VTOL aircraft and to improvements in air traffic control, reached the following conclusions:

- **Capacity and demand estimates** do not show a need for the fourth airport by 1965, and no new runways will be required until 1972.
- **Limiting of general aviation** activity to its present volume would eliminate the need for new runways until 1979.
- **Diversion of general aviation** movements from La Guardia, Newark and Idlewild would give those airports the capacity to handle airline traffic until after 1980.
- **Provision of additional** general aviation facilities at airports other than the above three, or at a new airport for general aviation, would provide additional capacity at substantially less cost than would be involved in the construction of a fourth general purpose airport.
- **Distribution of airline flights** among four New York area airports instead of the present three would penalize the airlines and airline passengers in terms of cost and convenience.

In order to predict the future volumes of traffic the New York airports will be required to handle, the United Research study first forecasts traffic levels on a national basis.

In 1965, the study predicts, U.S. domestic passenger miles will total 41.9 billion. By 1980, the total will reach 86.6 billion. Volumes forecast, the report notes, tend toward the lower end of a range of forecasts made in recent years. These forecasts were reviewed against actual 1960 traffic levels, and the indication was that traffic would not achieve the levels of the higher forecasts.

Total of U.S. domestic air passengers, according to the study, will reach 64.6 million in 1965 and 137.2 million in 1980.

Coach penetration of the total air traffic market will reach a maximum of 75% on stage lengths under 1,500 mi. and 80% on stage lengths over 1,500 mi., the study predicts. An exception is the 1,100-1,199 mi. stage length, which includes New York-Miami, and in which the coach penetration is expected to reach 80%.

Decade of Decline

New York's share of the national traffic has been declining for a decade and will continue to do so, according to the study. Among the reasons: greater expansion of economy and population in other areas, and the diminishing importance of New York as a connecting center for traffic. The latter situation is due to increased nonstop and through plane service from other points, which make New York connections unnecessary. Based on recent trends, the rate of decline of the New York Airports is about 0.5% every five years. Projecting this rate, New York will handle 14.65% of the country's passenger boardings in 1965, 14.14% in 1970, and in 1980 will handle 13.11%.

Passengers movements at the New York airports, the study forecasts, will total 18,928,000 in 1965, and rise to 35,974,000 in 1980.

The Port Authority's 1965 passenger estimate indicated a total of 24,700,000.

VTOL Diversion

VTOL-STOL operations on a commercial basis appear likely in the near future as a result of current technological developments, according to the United Research study. By 1970, this type of aircraft will divert from fixed-wing aircraft 75% of traffic on segments under 100 mi., the study predicts. On trips between 100 and 200 mi., the diversion will be 50%, and on trips between 200 and 300 mi. the diversion will be 25%.

This diversion will account for 13.2% of the New York area traffic for 1970, 1975, and 1980, according to the study. In terms of passenger movements, the VTOL-STOL total will be 4,749,000 in 1980. The diversion will be largely from small aircraft, so the reduction in the number of fixed-wing aircraft movements will be proportionately greater than the diversion of passengers.

International air travel in and out of New York is increasing more rapidly than domestic travel, the study finds. The domestic fare structure is evolving

Local Station Expense per Originating Passenger New York and Other U.S. Stations: 1958

Carriers	Local Station Expense [1]		Originating Passengers		Local Station Expense per Originating Passenger	
	New York [2]	Other U. S. Stations	New York [2]	Other U. S. Stations	New York [2]	Other U. S. Stations
American	$9,413,847	$34,547,704	1,489,988	5,701,158	$6.32	$6.06
Braniff	675,924	7,519,117	57,626	2,032,475	11.73	3.70
Capital	1,733,659	11,958,345	496,861	3,043,328	3.49	3.93
Delta	658,679	10,773,014	67,760	2,700,797	9.72	3.99
Eastern	4,200,881	19,439,037	988,548	5,943,332	4.25	3.27
National	2,010,287	5,998,884	321,602	1,232,755	6.25	4.87
Northeast	1,498,635	3,771,771	262,893	694,269	5.70	5.43
Northwest	1,655,327	6,958,106	164,910	1,392,516	10.04	5.00
United	6,003,561	33,876,408	543,065	6,196,398	11.05	5.47
Total	$27,850,800	$134,842,386	4,393,253	28,937,028	$6.34	$4.66

[1] Includes aircraft servicing, traffic servicing, servicing administration, and direct maintenance and depreciation—general ground property.
[2] Newark, La Guardia and Idlewild.

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in a manner that discourages traffic: Coach fares are being raised to 75% of first-class fares, although on transcontinental flights the percentage is about 63%. Trend is the other way in international travel: lowest fares are increasingly less than highest fares. Allowing for the effect of supersonic operations on overseas travel, New York's international passenger total for 1980 should be 21,902,000.

In estimating domestic passenger aircraft movements, the United Research study assumes among other things a 60% airline load factor on a year-round basis. Load factor trend is down, the study finds, and increased seating capacity per aircraft will hold the future annual average load factor to this point.

Cargo traffic will increase at a greater rate than passenger traffic, according to the study. The current proportion of about 1% all-cargo flights to total airline service on domestic routes will increase in the forecast period to 2%, and international all-cargo flights will account for 1% of total international scheduled service.

Because of the greater capacity of each jet over its predecessor transport, aircraft movements will not increase in proportion to traffic. Further, the rise in coach service will result in additional seats per airplane as the jet cabins are given over to higher density configurations.

Fixed-Wing Movement

Annual commercial fixed-wing transport aircraft movements at the New York-New Jersey airports in cargo and passenger service are estimated at 532,400 in 1965, up from 486,500 in 1959; the total will be 666,100 movements by 1975 and 846,200 by 1980.

Regarding the capacity of the airports to handle future movements, the study predicts the demand from airline aircraft at 116.8 peak-hour movements by 1965 and 185.7 movements by 1980. Current capacity of the three airports totals 150 movements per hour. General aviation movements would raise the requirement to 280 movements by 1980, according to the study.

However, technical improvements such as partial automation of air traffic control and high speed turn-off or drift-off runways can be expected to raise the capacity to 195-200 movements per hour. This estimate assumes that the new devices are 50% successful; if the percentage was 100%, capacity would rise to 240 movements per hour.

It is evident from the above estimates that limitation or removal of general aviation movements at the three airports would place their capacity well within the estimated demand for the forecast period, assuming

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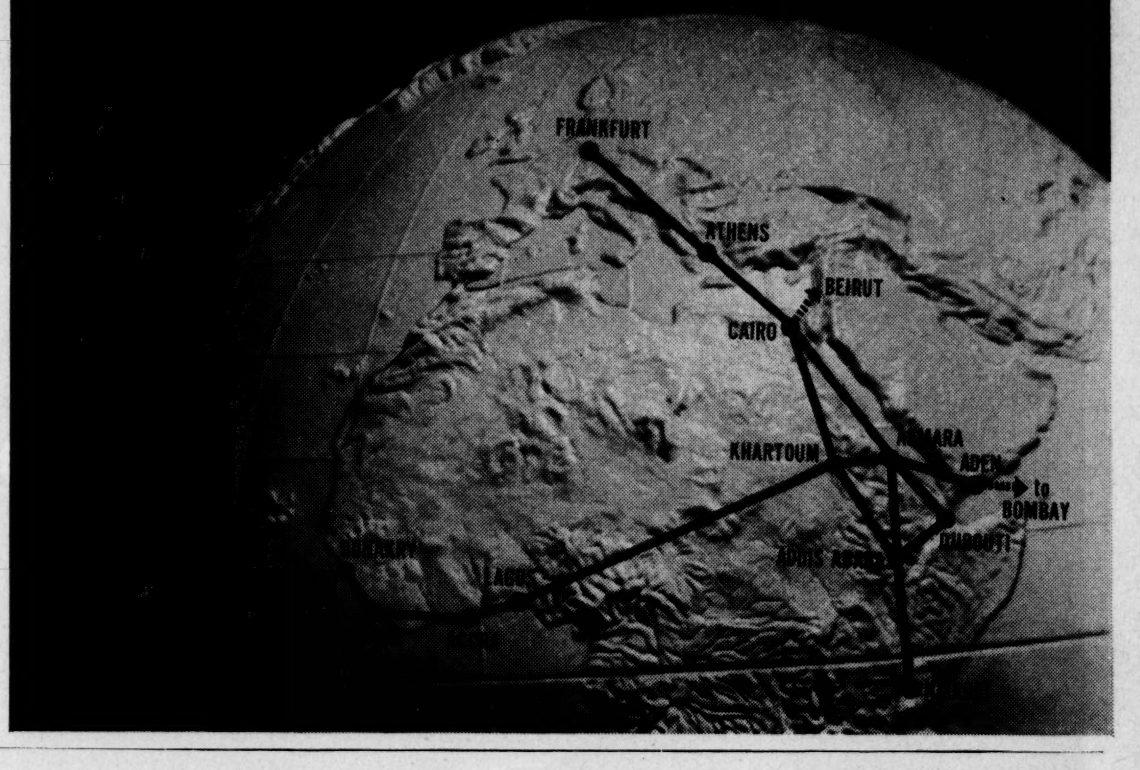

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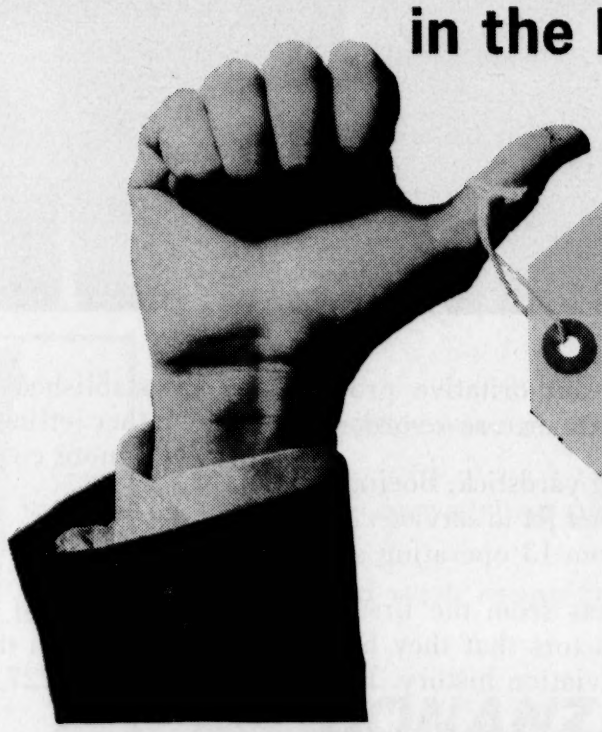

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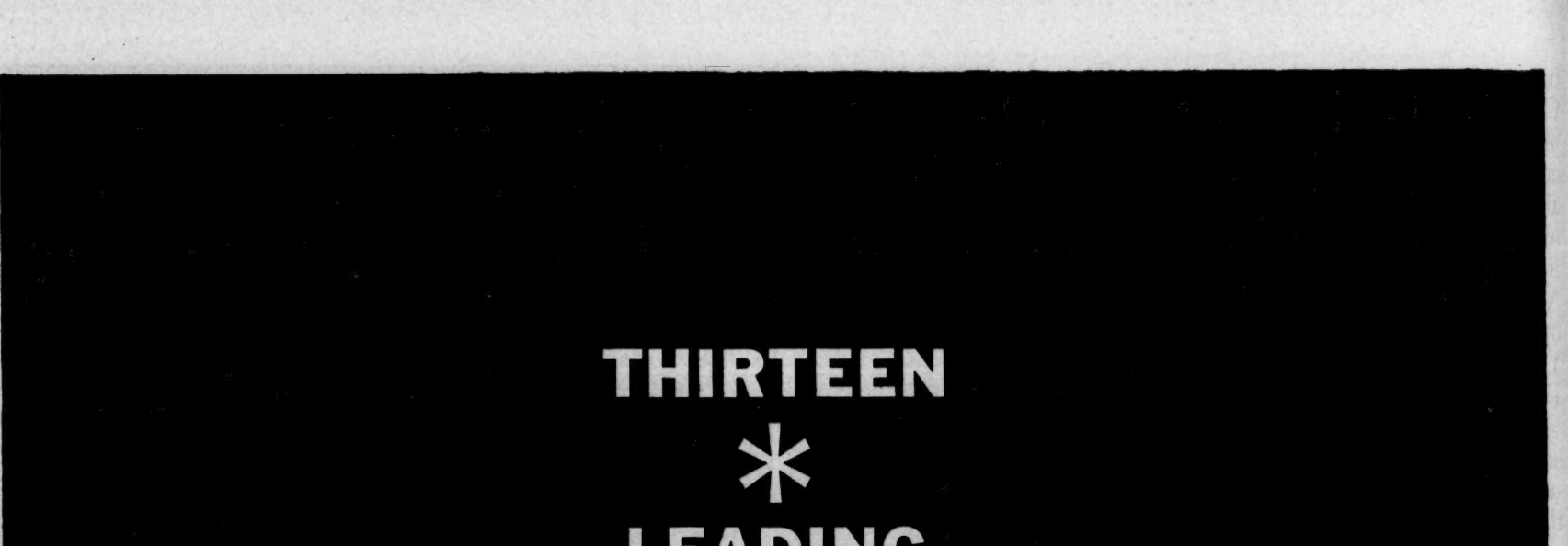

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the increased efficiency estimates are correct.

Airline views on splitting their regional operations even further with a fourth airport to serve are unfavorable, if a reasonable alternative is available.

The airline views, as it is summarized in the study, involves the following factors:

- **Past experience** has shown that a New Jersey location (Newark Airport) has been difficult to sell in the total New Jersey-New York metropolitan market.
- **Loads at Newark** have therefore tended to be lighter than those at La Guardia and Idlewild.
- **Connections between airlines** are complicated by the multiple airport setup. The problem is severe with the three airport situation and a fourth would complicate it further. About 20% of New Jersey-New York area passengers make connections.
- **Scheduling problems** also are complicated by the multiple airport complex. This applies to aircraft and flight crews. Connecting services are more difficult to schedule.
- **Station costs** are generally higher. Proportion of investment and other fixed costs are greater. A burden is placed on carriers whose route structures allow limited access to the total market represented by each airport.

Air Afrique Links 11 Pro-Western Countries

Paris—The recent and largely unheralded creation of a new African airline by 11 former French African territories marks the first serious check to Communist-bloc infiltration in West Africa's rapidly-expanding air transport system.

The new grouping—called Air Afrique—was set up by heads of the 11 French-speaking nations. The new airline will be developed with technical aid supplied by Air France and Union Aeromaritime de Transport (UAT), a private French carrier. The consortium includes all former French African territories except Guinea and French Sudan, now called Mali.

Guinea and Mali currently are receiving considerable air transport aid from the Communist bloc for their new national airlines, Air Guinea and Air Mali. A third West African nation, Ghana, also is operating Russian aircraft and getting technical aid from Communist-bloc countries as well as from western nations.

Creation of Air Afrique rounds out the possible nations in tropical regions where east and west could compete for leading roles in lending aviation aid and in selling aircraft.

On balance, the Communist bloc has done quite well. It has a strong position in two of West Africa's richest countries, Guinea and Ghana. It also has a firm position in Mali, a poor and politically confused nation. Moreover, Soviet infiltration into the aviation picture in the former Belgian Congo, though temporarily blocked, isn't completely eliminated.

Creation of Air Afrique suggests a new formula for organizing air transport in large regions of Africa. Up to now, most of the new African nations have sought establishment of their own national airline, rather than seeking the consortium arrangement.

Air Afrique, however, rejects the idea of national carrier systems and adopts a formula somewhat akin to the Scandinavian countries' SAS consortium. Each of the 11 nations holds 6% interest in Air Afrique while Air France and UAT hold 17% each. The new company will have headquarters at Abidjan, on the Ivory Coast. Initial capitalization has been fixed at $2 million. The first annual meeting is to be held May 25 at Abidjan and operation is to begin next July.

Initially, Air Afrique will operate 15 Douglas DC-4 aircraft currently used in West Africa by Air France and UAT. Routes at first will concentrate on linking the 11 nations.

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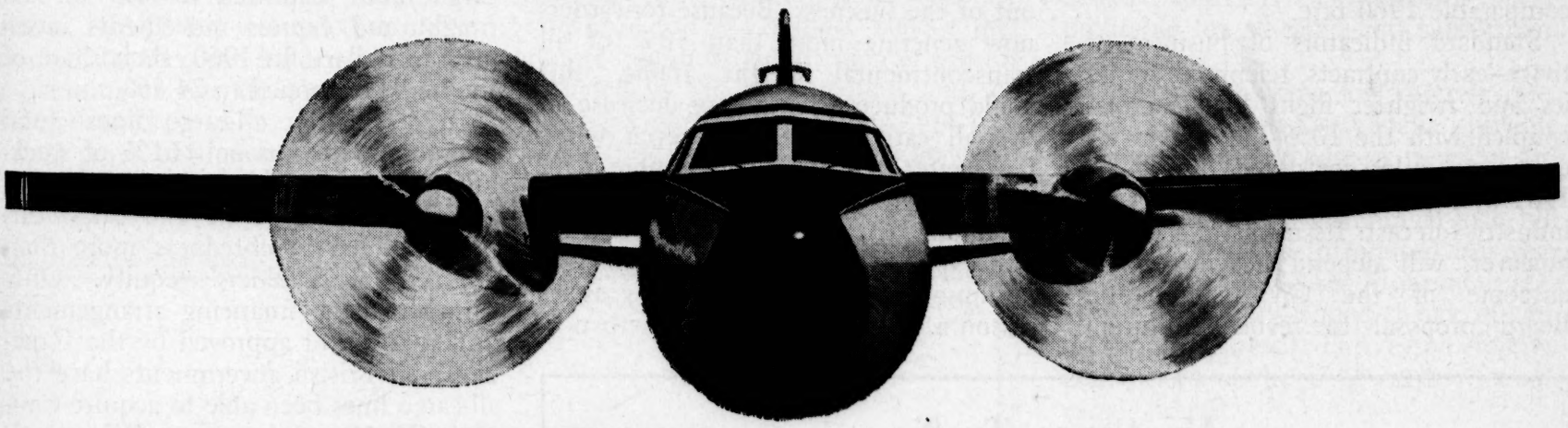

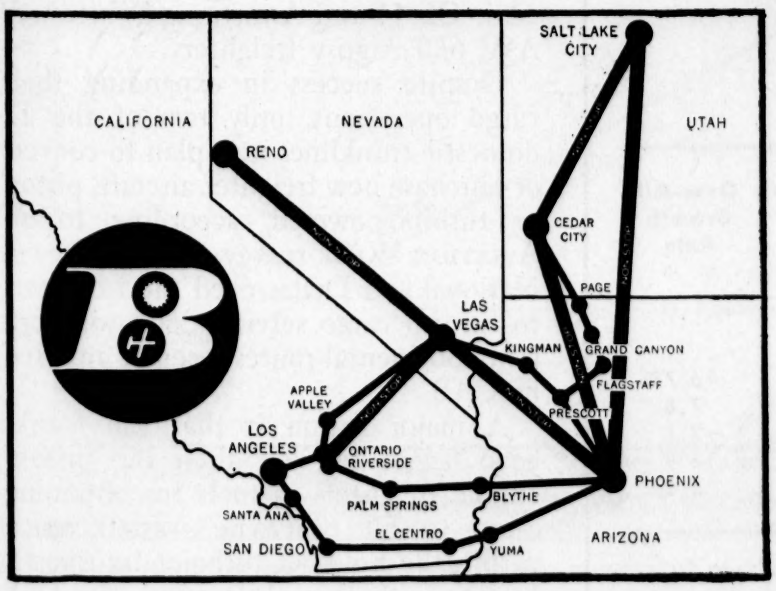

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Carriers Predict 1961 Air Freight Gains

By David H. Hoffman

The U.S. air freight industry, no longer waiting for its "big breakthrough," now expects 1961 to usher in an era of steadily falling costs complemented by healthy—but not spectacular—increases in traffic volume.

Whether the larger all-cargo lines can capture a sufficient share of the 1961 market to offset the expense of introducing new turboprop equipment is a major question this year. It is certain, however, that Flying Tiger, Seaboard, Riddle and Slick will make an all-out effort to reverse the trend toward trunkline dominance reflected by 1960's statistics.

Despite the plans of Flying Tiger and Seaboard to introduce large Canadair CL-44 freighters in July, trunklines are optimistic over 1961 freight prospects. Earlier apprehension that the CL-44 would permit economic rate reductions on the order of eight cents per ton mile has been allayed somewhat.

With the initial expense of jet transition behind them, the trunks now feel that they also can reduce rates by mechanizing the handling of freight at the terminal. Indirect costs associated with the loading and unloading of cargo run as high as 100% of direct operating cost for the trunks and as low as 50% of direct operating cost for the all-cargo carriers.

Based on a growing gross national product, continued expansion of capacity and a new concentration of sales emphasis on freight, the carrier's consensus is that the over-all industry growth rate will be approximately 15% this year. A disappointing 5% was the comparable 1960 rate.

Standard indicators of business activity—early contracts, telephone inquiries and freighter flight load factors—coupled with the 10% increase in revenue ton miles registered during the 1961 first quarter, seem to support the industry forecast. Its ultimate accuracy, however, will depend heavily on the outcome of the Civil Aeronautics Board proposal to revoke minimum rates for air freight (AW Mar. 6, p. 45). A decision is expected this summer.

CAB's minimum rate order was issued in 1948 to halt the ruinous competition that broke out after World War II, when hundreds of surplus military transports were placed on the market at bargain prices. Fear that revocation of the rate floor might restore this kind of competition was evident in initial trunkline and air freight forwarder response to the new CAB proposal.

The almost solid opposition of the forwarders is based largely on the assumption that competitive pressures and expanded capacities will lead airlines to drop the principle of lower rates for high-weight shipments. These volume discounts, or "spreads," often enable the forwarder to turn a profit by consolidating groups of small orders.

Should volume discounts disappear, many forwarders probably will be forced out of the business. Because forwarders now generate more than 50% of all transcontinental freight traffic, this could produce a temporary decrease in over-all cargo movements, even while lower rates were encouraging more manufacturers to ship by air.

Among the trunks, only American has expressed unqualified support of minimum rate revocation, giving as its reason a desire to experiment with new freight promotional schemes. American operates 13 Douglas DC-7F freighters. United, with six DC-7As and seven DC-6As in its freighter fleet, staunchly opposes the CAB proposal.

Among the all-cargo lines filing formal comment with CAB, Flying Tiger Line favors dropping the rate floor while Riddle favors keeping it. Slick, taking a position somewhere between the two, warns that "the bitter opposition of the passenger carriers to the all-cargo carriers is still translated into action as it was in the rate war leading up to the original minimum rate order."

Slick said CAB would not be able to detect when trunkline rates began to drop below trunkline costs because the passenger carriers do not have to file the same detailed cost information required of all-cargo carriers. Thus, the trunks could disguise uneconomic rates and "drive the all-cargo carriers out of business." Lacking fully allocated cost data, CAB would be powerless to intervene, Slick said, urging that means for obtaining such data be established while minimum rates were still in effect.

The statistics available indicate that the all-cargo lines failed to hold their own against last year's trunkline competition. In 1960, total revenue ton miles of freight and express moved by the trunks increased 12% over 1959, while total tonnage carried by the all-cargo lines fell 12%. In 1959, the all-cargo lines captured 29.4% of all freight and express movements measured in dollars. In 1960, their share of the market dropped to 24.5%.

In 1958, the all-cargo lines' total long-term debt was only 62% of stockholders' equity. This ratio was reversed in 1959, and in 1960 the cargo carriers' bonded indebtedness more than doubled stockholders' equity. Only through liberal financing arrangements underwritten or approved by the Canadian and British governments have the all-cargo lines been able to acquire Canadair CL-44 and Armstrong-Whitworth AW 650 Argosy freighters.

Despite success in expanding their cargo operations, only two of the 12 domestic trunklines now plan to convert or purchase new freighter aircraft, piston or turbine-powered, according to an AVIATION WEEK survey. And these two, National and Delta, need the freighters to furnish cargo service along southern transcontinental routes recently awarded by CAB.

A major reason is that the trunks have begun to view their big piston-engine freighters as tools for obtaining cargo to fill otherwise wasted space within the holds of turbojet transports. In line with this philosophy, the DC-

Air Cargo Traffic
Revenue Ton Miles
(Thousands)

Year	Total	Trunk Carriers	Local Service Carriers	All-Cargo Carriers	All-Cargo Carriers' Share of Total	Over-All Growth Rate
1955	335,309	223,620	2,758	107,945	32.2%	....
1956	391,310	240,301	3,311	148,112	37.9	16.7%
1957	421,672	261,184	3,724	156,764	37.2	7.8
1958	412,936	286,400	4,042	122,494	29.7	−2.1
1959	482,978	335,579	5,332	142,067	29.4	16.9
1960	507,071	376,389	6,266	124,416	24.5	5.0

Cargo includes only freight and express.

7Fs and Lockheed 1049Hs are being used to pioneer markets and to backstop regular passenger flights as extra sections when unusually high weight or high volume loads demand prompt shipment.

After up to two full years of experience with the piston freighters, trunkline cargo departments are reaching the conclusion that high breakeven load factors—over 70% in some operations—rule out additional conversions. As a result, emphasis has shifted to sales.

The percentage of total revenue ton miles carried by all-cargo aircraft reflects this thinking. In 1957, freighters accounted for 241,578,000 revenue ton miles or 57.3% of the trunkline, local service and all-cargo line total. In 1959, freighters logged 230,307,000 ton miles, and for the first year since 1946, failed to account for at least 50% of the total.

Last year, according to preliminary figures compiled by CAB, freighters had only 47.3% of the market, logging 239,784,000 revenue ton miles.

All-cargo lines and some supplemental carriers hope to stabilize their operations this summer when Military Air Transport Service is expected to award $65-70 million worth of overseas, Logair and Quick Trans contracts, effective during Fiscal 1962. Since the Eisenhower Administration issued an order recalling military dependents from abroad, overseas contracts have generally been awarded on a quarterly basis.

Logair request for proposals is due this month and probably will include contract possibilities totaling $30 million. In conferences with interested carriers, MATS has stressed that preference will be accorded bidders operating, or planning to operate, the more modern transports.

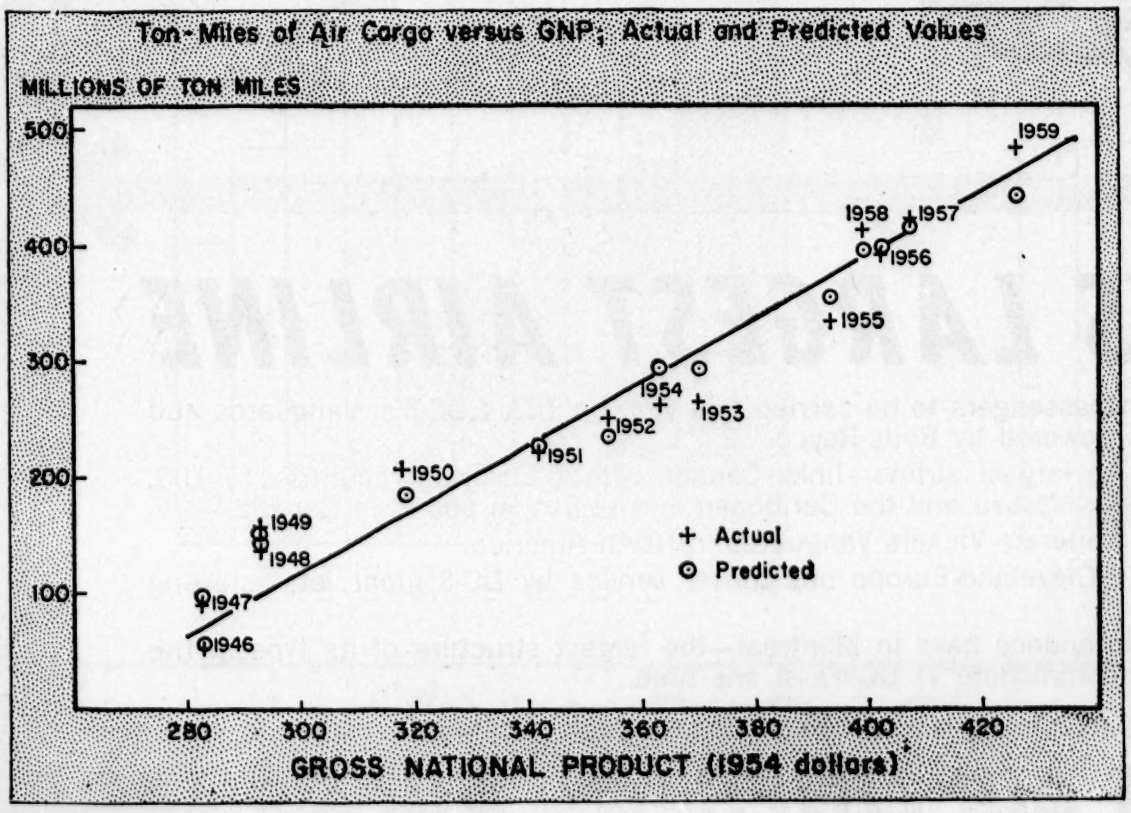
Last year's bid request contained performance and design specifications for an aircraft capable of hauling "outsize cargo" over long-range route patterns. Only production transport capable of meeting these specifications was the Lockheed C-130. Airlines believe that almost identical requirements will be included in the 1961 request and, on the basis of this assumption, are now negotiating with Lockheed in an effort to complete financing in advance.

These other possibilities, now being studied by MATS, Department of Defense, CAB and Congress, could make Logair contracts substantially more profitable for all-cargo and supplemental carriers:

- **Legislation making low interest rate,** government guaranteed loans available to finance the purchase of freighter aircraft. Despite trunkline opposition, proponents feel that a guaranteed loan bill similar to the one introduced last year by Sen. A. S. Mike Monroney (D.-Okla.) now stands a good chance of congressional approval. The reason: foreign penetration of the U.S. market for all-cargo aircraft.
- **Modification of Logair's** independent route patterns. Instead of flying from one military base to another with plane-load lots of government cargo, carriers have asked permission to combine Logair routes and contracts with the common carriage of freight. Department of Defense apparently favors such a system, while MATS opposes it.
- **Application of minimum** ton-mile rates to all government contracts with commercial carriers. Such rates now apply to MATS overseas charters. Carriers bidding for Logair contracts, however, quote plane-mile rates that in past years have been near, if not below, the breakeven point.

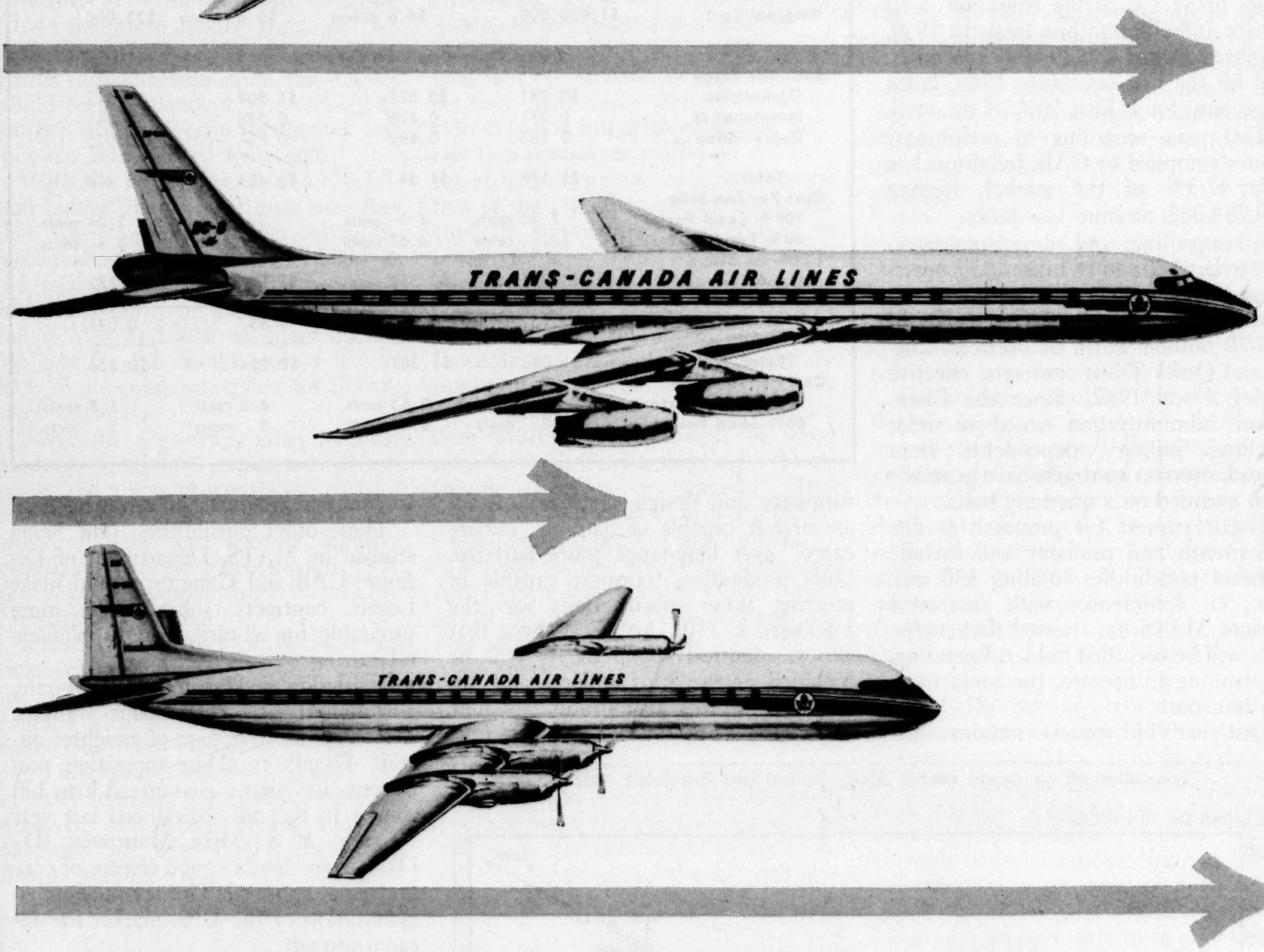
Comparison of Cargo Truck and Aircraft Characteristics and Costs

	Converted Piston Transport	Turboprop Cargo Transport	Turbofan Cargo Transport	Longhaul Cargo Truck and Trailer
Empty Weight	73,200 lb.	115,000 lb.	130,000 lb.	22,500 lb.
Tons of Payload	15	38	47	20
Block Speed in MPH.				
800 mi.	270	355	405	35
1,200 mi.	295	375	430	40
2,500 mi.	315	395	470	45
Daily Utilization	6 hr.	6 hr.	6 hr.	6.5 hr.
Daily Ton Miles				
800 mi.	24,300	80,940	114,210	4,550
1,200 mi.	26,550	85,500	121,260	5,200
2,500 mi.	28,350	90,060	132,500	5,950
Depreciation	4 yr.	7 yr.	10 yr.	5 yr.
Original Cost	$1,950,000	$4.6 million	$5.6 million	$23,000
Direct Operating Cost Per Mile				
800-Mile Stage				
Operations	$0.741	$0.622	$1.208	$0.312
Maintenance	0.271	0.426	0.556	0.061
Depreciation	0.165	0.492	0.721	0.035
Total	$1.177	$1.54	$2.485	$0.408
Cost Per Ton Mile				
100% Load Factor.	7.85 cents	4.1 cents	5.4 cents	2.04 cents
60% Load Factor.	13.1 cents	6.67 cents	9 cents	3.4 cents
1,500-mi. Stage				
Operations	$0.705	$0.560	$1.100	$0.272
Maintenance	0.216	0.384	0.502	0.053
Depreciation	0.159	0.443	0.652	0.031
Total	$1.080	$1.387	$2.254	$0.356
Cost Per Ton Mile				
100% Load Factor.	7.2 cents	3.65 cents	4.8 cents	1.8 cents
60% Load Factor.	12 cents	6.09 cents	8 cents	3 cents



IMPACT of the gross national product on the movement of cargo by air is plotted above.

PROGRESS REPORT FROM TCA



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TCA PROGRESS Now world's 7th largest airline—links Canada with 7 European countries, 7 U.S. cities, Bermuda, Nassau and the Caribbean and serves 50 points in Canada.

TCA PROGRESS First airline to operate Vickers Vanguards in North America.

TCA PROGRESS First and only Cleveland-Europe one-carrier service by DC-8 giant jets—starting this month.

TCA PROGRESS New TCA maintenance base in Montreal—the largest structure of its type in the world—can accommodate 11 DC-8's at one time.

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TRANS-CANADA AIR LINES TCA **AIR CANADA**

Tillinghast Outlines TWA Turbofan Needs

By William H. Gregory

New York—Trans World Airlines' new president, Charles C. Tillinghast, Jr., faces three major problem areas as he takes over the airline's top job, vacant since last summer.

In order of immediacy, he ranks them:

- **Equipment requirements** of the airline.
- **Merger** with Northeast Airlines.
- **Economics** in the broad sense.

TWA will deal only with phase one of its equipment problems now. This is for additional long-range equipment to bring its fleet into balance with its domestic transcontinental and international competitors, especially with United Air Line's growing fleet.

Initially, Tillinghast said, TWA probably will order at least 20 Boeing 707-131B and 707-331B turbofan transports.

Negotiations for financing the purchase, on the order of $100 million, are under way with generally the same group that provided TWA's financing for purchase of its present fleet of 707s from Hughes Tool Co. and for its fleet of Convair 880s (AW Jan. 9, p. 38).

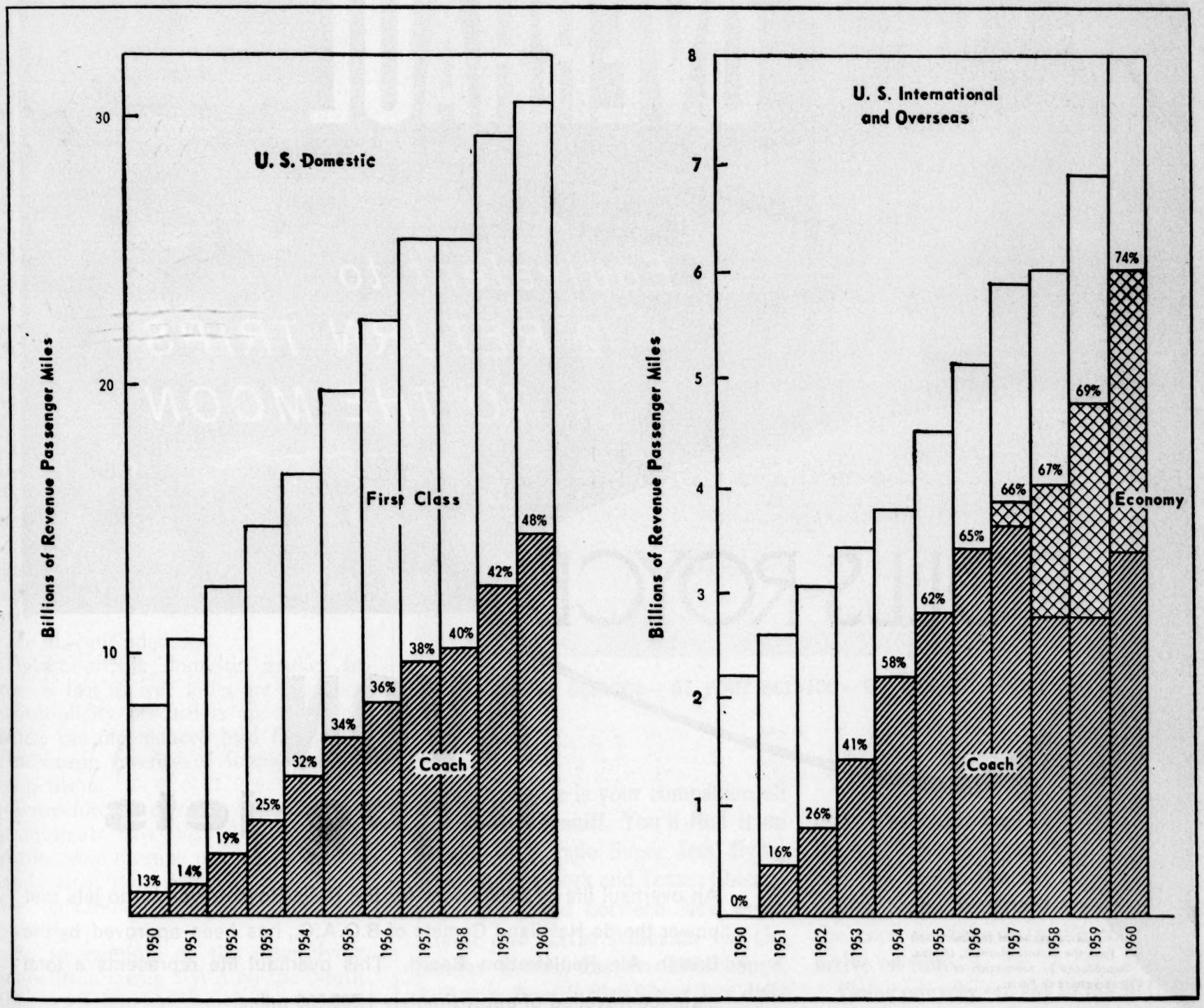
New Funds

Tillinghast thus finds himself seeking new funds while final arrangements for a $110-million issue of TWA debentures due this month still are being completed. However, bank and insurance company loans—debt capital—are sought for the new order rather than additional equity.

Relatively short-haul routes can be adequately handled for the near term by the 880s, Tillinghast said. TWA's experience has shown this airplane appears to operate economically on stage lengths down to about 500 mi.

No cargo configurations are planned in the current order, Tillinghast said. Purchase of either a cargo type jet aircraft or a short-range jet transport of the Sud Caravelle, Boeing 727, or de Havilland Trident class, is farther down the road. How far, he said, will depend a good deal on financial considerations.

In his initial message to employes, Tillinghast commented that meeting the airline's equipment financing needs will tax its resources severely. "In my opinion," he said, "we can adequately meet these needs only if we prove ourselves capable of operating with consistent profitability. No matter how



Coach vs. First-Class Passenger Volume

Steady increase in volume of coach traffic compared with a leveling-off of first-class traffic is forcing most U. S. domestic and international airlines to revise seating configuration of turbojet aircraft to accommodate the growing demand for coach. Best forecasts indicate that coach traffic will account for about 55% of all traffic by the end of the year.

A MILLION MILES WITHOUT AN OVERHAUL

Equivalent to
2 RETURN TRIPS
TO THE MOON

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AVON
turbo jets

Illustration based on photograph from the Science Museum, London. Reproduced by permission of L'Observatoire de Paris.

An overhaul life of 2,600 hours for the Rolls-Royce Avon turbo jets that power the de Havilland Comets of B.O.A.C., has been approved by the British Air Registration Board. This overhaul life represents a total distance travelled of approximately 1,000,000 miles.

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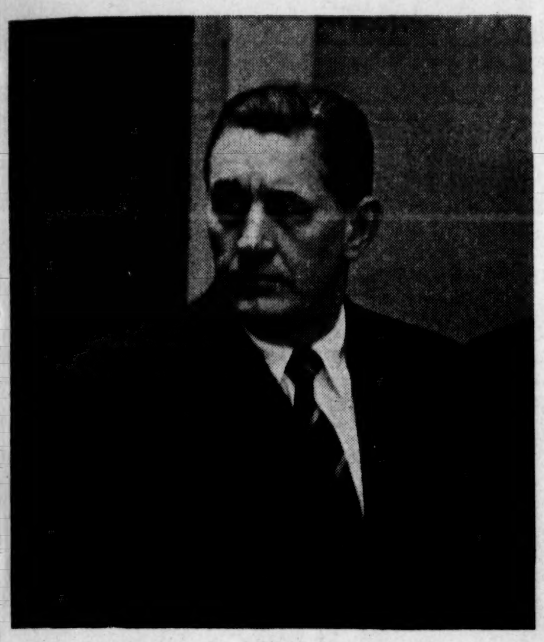


CHARLES C. TILLINGHAST, JR.

valid the reasons for failing to earn a profit, they can never be as persuasive to the sources of capital we require as adequate profits are."

The question of profitability is tied to both the second and third tasks on Tillinghast's list. Northeast's Florida route would alleviate a disadvantage of TWA's route system—the lack of a southern route to offset winter season traffic declines.

TWA is not necessarily interested in the Florida route exclusively, Tillinghast said, though recognizing the value of Miami as a gateway to the Caribbean area and South America as well as a market itself. Merger with Northeast also would carry with it a problem for TWA in Northeast's short-haul New England routes with their heavy peaks and valleys in traffic, depending on day of the week or season.

Though Northeast declined another extension on a decision requested by TWA (AW Apr. 10, p. 41), both airlines still are keeping the door open.

Off-season traffic lulls are one of the various problems Tillinghast lumped under the general category of economics.

He also included:

- **Failure** of the domestic market to grow as fast as seat miles are growing.
- **Multiplicity** of carriers on the same routes, causing reduced load factors.
- **Increasing severity** of foreign carrier competition.

Some foreign carriers, subsidized by governments, have the view that if they take in more revenue outside their own nation than they spend, it is a profitable operation, the TWA president asserted.

As an example of the intensifying competition facing TWA on the North Atlantic, Tillinghast noted the current campaigns of both El Al Airlines of Israel and Air-India International to identify themselves with New York-London or New York-Paris routes, rather than routes to their homelands.

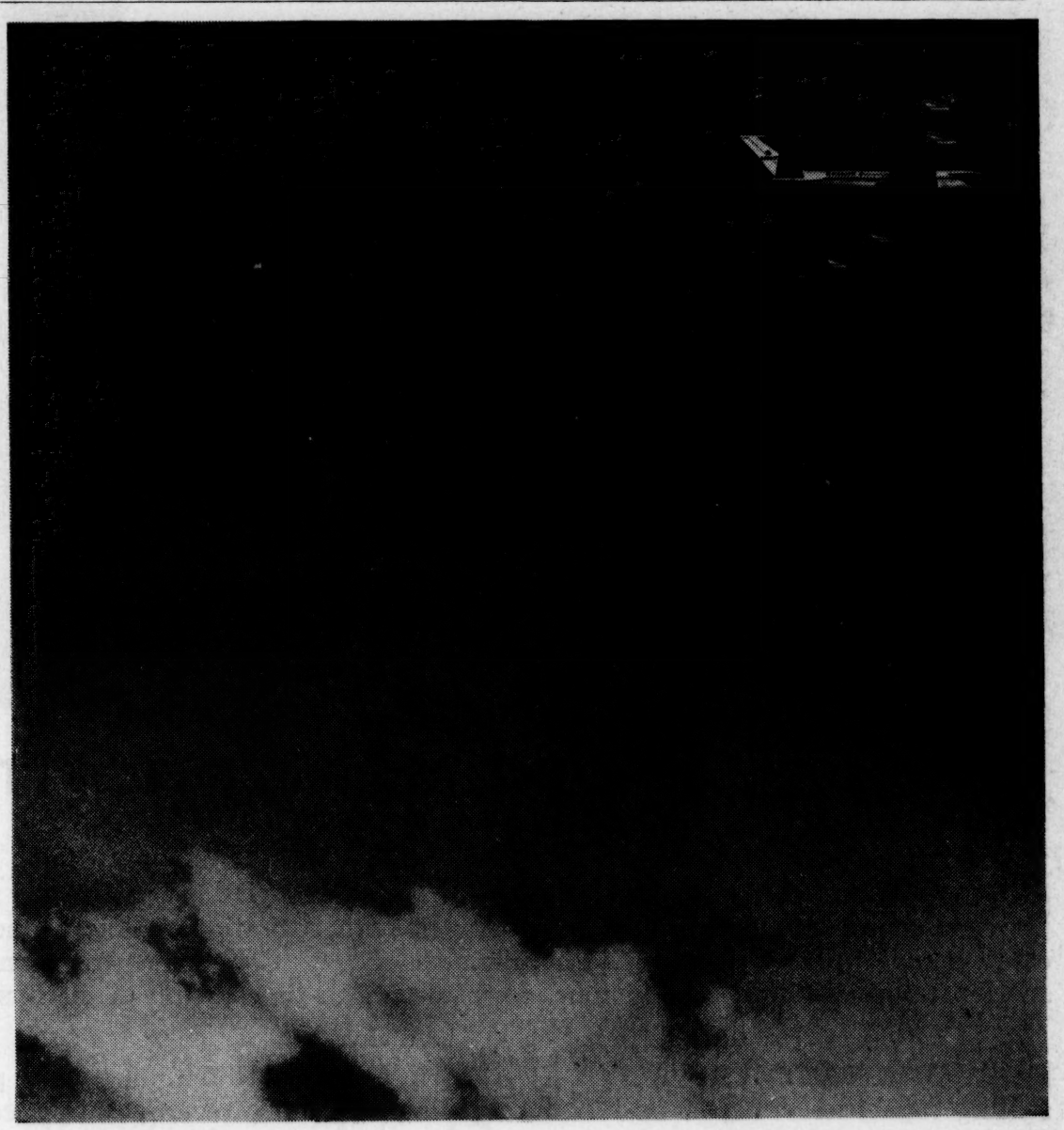
Technically, U.S. airlines can perform an outstanding job, Tillinghast said. But they face tough problems in competing on the economic level. Tillinghast feels the U.S. may be forced into limiting flights from other nations as the only solution.

For these reasons, Tillinghast expects TWA, like the rest of the industry, to have an indifferent year in 1961. "Indifferent," he said, "meaning nearer to bad than good." First quarter results were unusually bad, he said, and will be difficult to outbalance during the rest of the year.

In his previous business career, as a lawyer and later as vice president-international operations for the Bendix Corp., Tillinghast flew 75,000-100,000 mi. a year as an airline passenger. As a result, he has some strong feelings on passenger service.

Reliability in schedules is one. A businessman who leaves New York in the morning for an appointment in Detroit for lunch is concerned first with getting there on time rather than service extras. TWA's job is to provide both, he said.

Tillinghast's influence can thus be inferred in TWA's new passenger service campaign stressing on-time performance, and in a series of meetings on customer service at New York and



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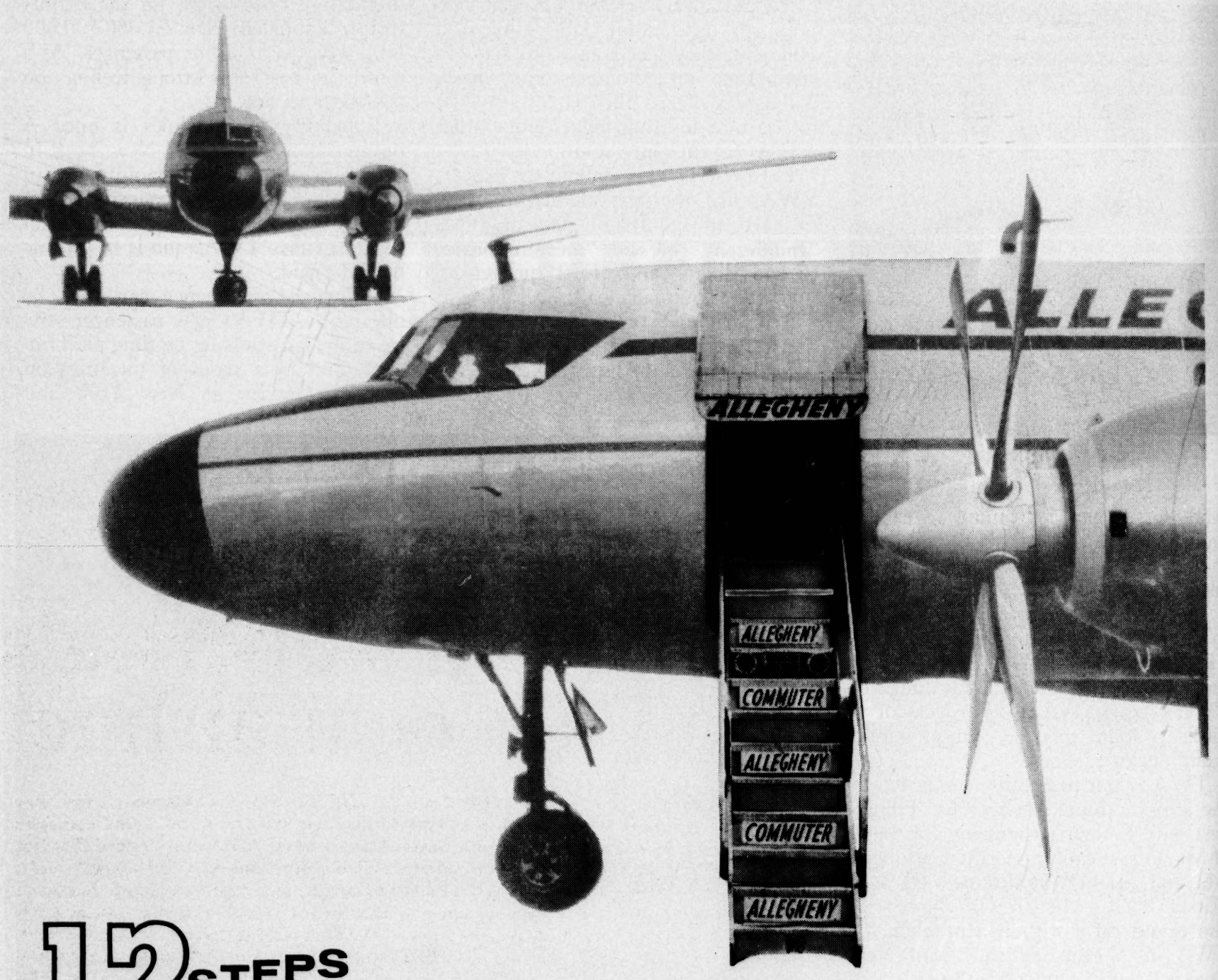

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Jet power for the Canadair/Convair 540 is the 3500 ehp Napier Eland turboprop, designed and built for local service air transport by manufacturers with a tradition of more than 150 years of engineering leadership. World-wide parts and service support is provided by Napier, and Canadair, Ltd., a subsidiary of the General Dynamics Corporation. Now in regular service in North America with ALLEGHENY AIRLINES, INC., QUEBECAIR, INC., and the ROYAL CANADIAN AIR FORCE.

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Kansas City during his first two weeks in office.

Another point he emphasizes is explanation of delays. Uncertainty disturbed him as a passenger—whether a flight delay would be 15 min. or 2 hr. can make a big difference in business travel. An important part of solving this problem may be the airline employe dealing with passengers who may not know the exact details of the situation and fears getting himself out on a limb with an answer.

Internal Situation

As to the TWA internal situation, Tillinghast said:

- **Howard Hughes** and he have not met. His attitude as to the relations between the trustees of the Hughes controlling stock interest in TWA and the board is that he has enough operational problems to deal with now to keep him busy.
- **No organization** changes or personnel shifts are planned at the moment.

Tillinghast, in contrast to some of his predecessors has taken a "no fireworks" approach to the job. Some observers believe part of the reason for his selection was to reinforce the climate of stability sought by the lenders who forced the placing of Hughes' stock in trust.

Vought Modifies Wind Tunnel for V-447 Test

Dallas, Tex.—Requirement for testing a large model of its V-447 design proposal in the tri-service vertical takeoff and landing competition necessitated modification of Chance Vought Corp.'s low-speed wind tunnel.

V-447 VTOL model has a 7-ft. wingspan. To avoid undesirable wall effects that would occur if it were mounted in the tunnel's normal 7-ft. x 10-ft. throat area, a new test position was built at the tunnel's largest section, which measures 21-ft. x 23-ft.

Because of the complexity of VTOL models and their control systems, they must be built larger than conventional aircraft models. Also, much of the testing is done at very low tunnel airstream speeds, and it is in this regime that wall interference is pronounced at a time when lifting surfaces of the VTOL model are operated at or near stalled conditions and lift is augmented to a large degree by propulsion devices.

Modification of the tunnel required cutting holes in the side and top of the rectangular-shaped tunnel and installing observation and control facilities in this area. The new test section was ready to operate in less than a month, providing wind speeds of up to 35-mph. Since January, the company has compiled more than 600 hr. of test and data analysis on the Chance Vought-Hiller-Ryan team proposal.

Model of the V-447 is equipped with small hydraulic motors, rather than the more expensive electric type generally used for tunnel testing. Each motor developes 25-hp. and spins Fiberglas propellers. Hydraulic fluid under 3,000 psi. turns the motors to spin the props at 9,000 rpm.

A further test site also has been built adjacent to the tunnel. Measuring 60-ft. x 90-ft., and canvas-wall enclosed to prevent surface wind disturbance, this area will be used to test the V-447 model's hovering capabilities.

Pakistan Line Buys 3 Turbofan 720Bs

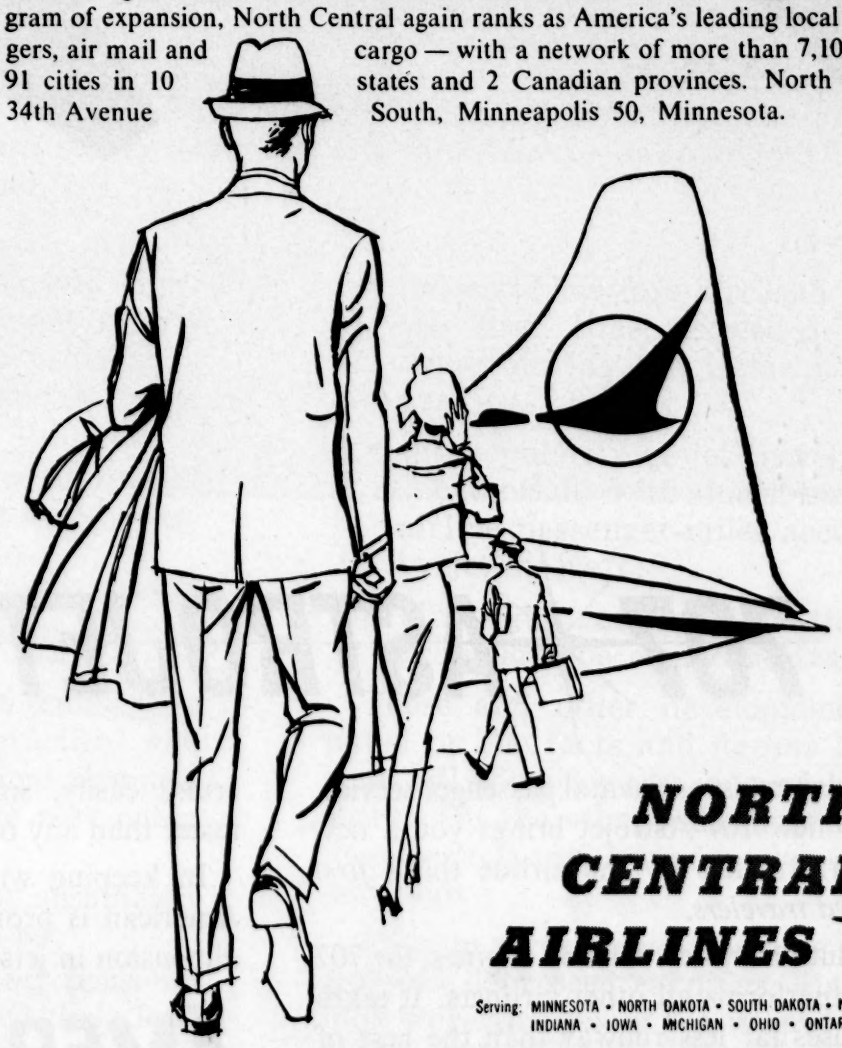
Pakistan International Airways will take delivery of the first of three Boeing 720B turbofan transports in December and will receive the remainder about a year later.

The airline has been flying a leased Boeing 707 Intercontinental jet transport since March, 1960, on its main Karachi-London route, with stops at Tehran, Beirut, Rome and Geneva.

The 720Bs will have a 100-120-passenger capacity in mixed configuration.

New records, new routes for America's leading local airline

1960 was another record year for North Central The airline inaugurated its first international operations with two routes to Port Arthur/Fort William, Ontario, and completed arrangements for a third route to Regina, Saskatchewan, early in 1961 Added Cleveland and 15 Michigan cities (and now serves more cities in that state than any other airline) Became the first local airline to carry one million passengers in a single year Is now the second largest airline in the nation in number of cities served With this continuing program of expansion, North Central again ranks as America's leading local airline, first in passengers, air mail and cargo — with a network of more than 7,100 route miles covering 91 cities in 10 states and 2 Canadian provinces. North Central Airlines, 6201 34th Avenue South, Minneapolis 50, Minnesota.



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A STATE OF THE INDUSTRY AND PROGRESS REPORT

The enormous contributions the nation's airlines are making to the commerce, economy, and over-all strength and progress of the United States are reflected in this report covering the year 1960. This report also shows, however, that in so serving our country, our airlines in 1960 again experienced a year of depressed earnings which seriously threatens their financial stability and limits the possibilities of their continuing to expand and improve their services.

In 1960, despite record traffic volumes and gross revenues, the airline industry's net profits were lower than in any year since 1948. It was the fifth consecutive year of what the Civil Aeronautics Board has termed "a relatively extended period of depressed earnings which cannot lightly be dismissed."

More service was provided in 1960, and more passenger, freight, express and mail traffic was carried than in any previous year. During the year, the airlines added several hundred new jet-powered planes and committed additional hundreds of millions of dollars to the purchase of more new jets, safety advances, and facilities for improved airline service on the ground.

This constant forward progress, characteristic of airline management efforts over the years, not only has provided a stimulant to national economic activity, but also has—

- ★ exerted a continued growing impact on community development and progress throughout the nation;
- ★ emphasized the airlines' major role in the foreign trade position of the United States; and
- ★ elevated the air transport industry to where it has become a practical and symbolic element of national strength in the ideological struggle now being waged in the world.

The year was marked also by significant developments and trends such as:

- ★ In a period of expanding personal travel, the airlines widened their lead over other forms of public passenger transportation;
- ★ domestic low-fare aircoach traffic, for the first time, exceeded first-class travel during the latter part of the year;
- ★ the popularity of jet travel increased substantially with almost half the total airline passenger-miles accounted for by jet aircraft;
- ★ airfreight continued as the fastest-growing type of airline traffic.

These and other developments illuminated by the facts and figures in this report tell the progress side of the airline story. On the other side, however, is the most serious problem of inadequate airline earnings.

Even in a year when business in general suffered depressed earnings, airline earnings were far below the norm. Thus, the average U. S. corporation made 5¢ profit on every $1 of sales, but the trunk airlines

needed to do $83 worth of business to make a profit of five cents.

The Government has taken an initial step to help strengthen the airlines earning position. Last year, after an exhaustive 4½-year investigation, CAB concluded that the airlines needed earnings equivalent to a 10½ per cent return on capital investment.

A vast improvement in profits is needed, of course, to achieve that earnings level. At the same time, other corrective steps are necessary. Thus, the Government, to improve profits, must move decisively to:

- ★ eliminate the World War II tax on passengers which stifles needed traffic growth;
- ★ end needless competition for private carriers provided by MATS, the Government-owned airline;
- ★ discontinue Government traffic-procurement practices which force unreasonably low rates on airlines and other common carriers; and
- ★ cope with the growing foreign airline threat.

Unquestionably, obstacles such as those must be removed. And future Government policies and actions must reflect awareness of the national need for an economically strong air transport industry and the fact that the airlines, in 1960, earned only about 1/59th of what the Government itself has determined is necessary to serve that national need.

We have, in this report, summarized the progress and results of 1960, the more pressing problems, and have taken a look into the future; this in addition to our annual presentation of detailed industry statistics.

Although numerous major United States industries had a business fall-off in 1960, the U. S. certificated airline industry enjoyed record business volume. The airline results show consistency with national economic patterns, however, in that the rate or pace of airline traffic growth slowed down last year.

This is reflected in results in key traffic areas as follows:

- ★ 57,700,000 passengers carried in 1960, up 3,000,000 over 1959—as compared with a gain of some 7,000,000 the previous year.
- ★ 38.8 billion revenue passenger-miles in 1960, up 2.5 billion over 1959—as compared with a gain of 5 billion the previous year.
- ★ 643.8 million ton-miles of airfreight in 1960, up 61.4 million over 1959—as compared with a gain of 88 million the previous year.
- ★ 58,948,000 ton-miles of express, a gain of 2.3 million ton-miles over 1959—as compared with a gain of 8 million the previous year.

An exception to this general trend was in the field of mail carriage where growth in 1960 outpaced that for the previous year. Thus, the airlines last year carried 240,580,000 ton-miles of U.S. mail, up 40.3 million over 1959—as compared with a gain of 22.7 million in 1959.

Total operating revenues of all U. S. scheduled airlines reached a record $2,882,552,000 in 1960, a gain of 10.4 per

THE AIRLINE STORY

Ever Increasing Usefulness Over The Years

All classes of Certificated Air Carriers	1939	1949	1960
Number of Airlines	23	45	56
Cities Served (excluding Alaskan points)	286	638	721
Aircraft in Service	347	1,083	1,848
Seats Available (Daily)	5,100	35,900	121,839
Cruising Speed of Fastest Transport	220 mph	315 mph	615 mph
Number of People Employed	13,300	76,000	166,408*
Total Airline Payrolls	$24,000,000	$349,000,000	$1,106,189,000[2]
U. S. Mail Ton Miles	8,610,000	61,144,000	240,580,000
Number of Passengers Carried	1,864,000	16,723,000	57,700,000
Average Fare Per Pass. Mile	5.62¢	6.23¢	6.01¢
Ton Miles of Freight Carried	2,713,000[1]	112,500,000	643,792,000

[1] Freight and Express combined.

[2] Early figures for Alaska not available but in 1960 there were 242 points served.

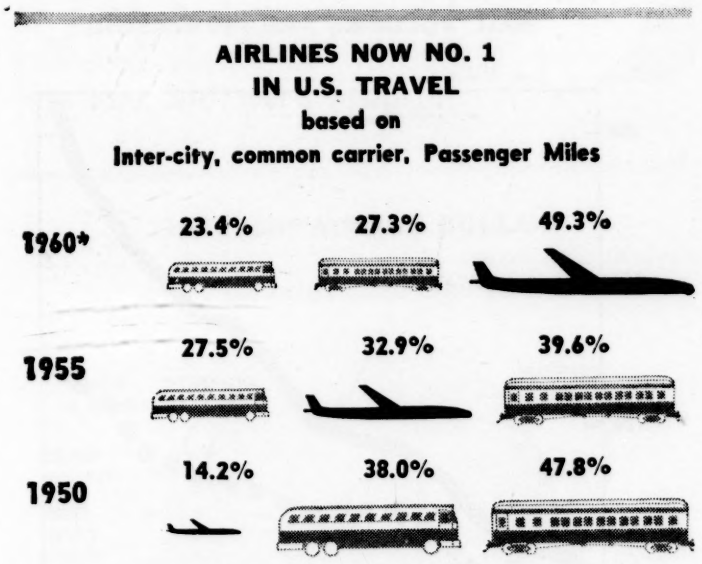
* Includes Estimates

cent over 1959. Similarly, total operating expenses rose to a record high total of $2,803,575,000 last year, or 12.6 per cent more than the previous year.

Net profit, after taxes and interest, for all carriers was $9,579,000, down $61,928,000 from the 1959 total of $71,507,000.

Passenger Service: The field of airline passenger service was marked in 1960 by such things as:

- ★ Continued service and traffic growth;
- ★ A widening of the passenger-mile gap in favor of airlines over other forms of public transportation;
- ★ Fare adjustments;
- ★ A shifting trend in classes of passenger traffic;
- ★ Emphasis on ground service improvements.



Last year, the airlines provided an all-time high volume of service—65.5 billion available seat-miles, a gain of 6.2 billion over 1959 and more than four times the amount of service provided just ten years ago.

The record volume of traffic thus accommodated—38.8 billion revenue passenger miles—occupied 59.2 per cent of available capacity, a passenger load factor figure which compared with 61.2 per cent in 1959 and 59.3 per cent in 1958.

This constant growth in airline service and public demand therefore, is, of course, one of the most significant elements in our fast-changing world. Ten years ago, the public relied chiefly on railroads and buses for common carrier service between U. S. cities. In 1960, domestic inter-city passenger-miles of the airlines were about as much as those of railroads and buses combined, further widening a lead the airlines assumed in 1957.

As a result of management efficiencies and rapid technological advances, the cost to the public for air transportation has been notably resistant to inflation.

Thus, since 1938, domestic air passenger fares have increased only 13 per cent, as compared to an increase of 100 per cent in consumer prices and 49 per cent in railroad fares over the same period.

The slight air fare increase includes that called for in mid-1960 in the Civil Aeronautics Board's finding that airline profits were too low. That increase amounted to 2 per cent plus $1 per ticket.

Significantly, there occurred in 1960 a marked increase in the provision of low-fare coach service by domestic carriers and in the utilization of that service by the public. Thus, there was an increase of 19.6 per cent in available coach seat-miles in 1960 over 1959, and an increase of 18.1 per cent in coach passenger-miles.

On the other hand, there was an absolute decline in first-class passenger-miles of 5.1 per cent last year. As a result, coach accounted for 47.2 per cent of total domestic passenger-miles in 1960, up from 42.0 per cent the year before. In several months during the last half of 1960, coach passenger-miles rose to over 50 per cent of the total. Fares for this service, of course, are 25% or more under regular first-class fares.

Meanwhile, the airlines devoted increased attention and resources to improving ground services for airline passengers. The growing scope of this undertaking can be seen in the fact that 50,000,000 reservations were handled by domestic airlines last year and 120,000,000 annually are expected by 1970.

Currently, the airlines spend some $93 million a year in this area. Additional millions are being poured into new systems of vast complexity and maximum efficiency. One airline, for example, has put $2,250,000 in a system whereby its agents in almost 100 cities can find out instantly seat availability up to six months ahead on 60,000 itineraries.

Another is installing a centralized automatic system which, in about a year, will serve 1100 sales desks, handle 7500 reservations an hour, process them in 3 seconds

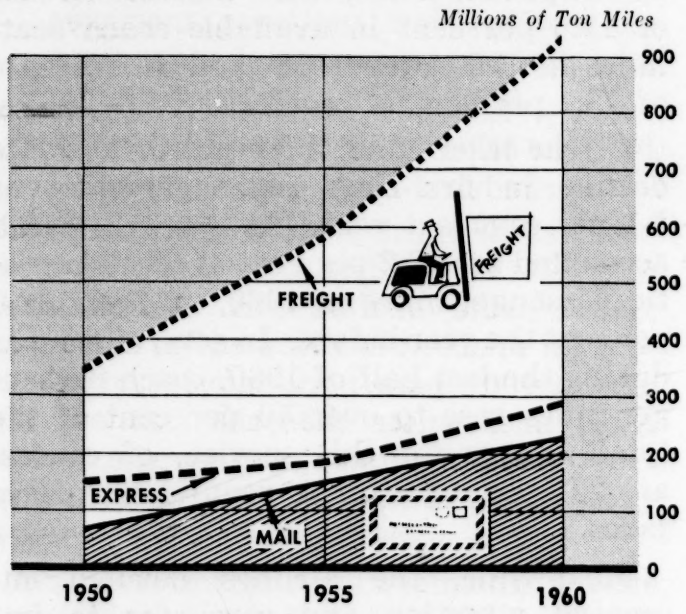
(as compared to 45 minutes now), reduce errors—and cost $5,000,000 per year.

Throughout the industry, online and interline facilities are being geared to the fast-growing market that must be accommodated.

Airfreight Service: Airfreight developments in 1960 were highlighted by a substantial increase in the cargo-carrying capacity of the certificated airlines. Mainly, this resulted from the greater cargo space aboard the big new jets plus the conversion of many late-model piston-engined planes to all-cargo configurations.

Significantly, there will be a further substantial increase in airline cargo capacity this year as more new jets and converted planes come into service and several carriers take delivery on new prop-jet airfreighters.

AIRLINES CARGO REACHES NEW HIGH



One immediate effect of this build-up in capacity is that it is requiring a complete re-examination of the entire airfreight rate structure.

Last year's freight volume reached a record high of 643,792,000 ton-miles, up 9.7 per cent over 1959, and 45 times the volume carried in 1946, the first full year of industry airfreight operations. As a result of this rapid growth, airfreight is the second most productive form of traffic carried by the airlines, accounting for 12.5 per cent of total ton-miles of traffic.

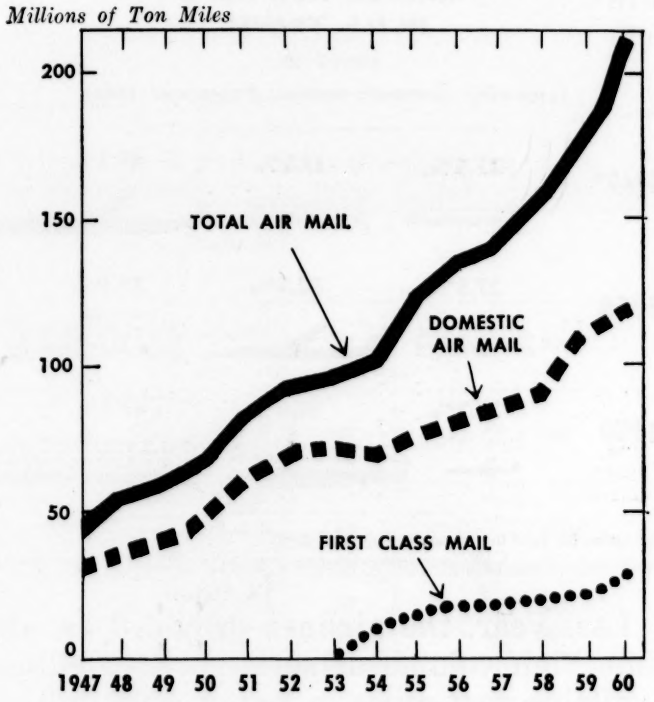
Nevertheless, the airlines are gearing themselves to carry much greater quantities. Last year's volume, for example, while a record high for the airlines, represented only .05 of one per cent of the total inter-city freight ton-miles moved by all forms of transportation in the U. S.

Great quantities of Government freight, of course, are moved annually via MATS, the Government-owned airline. Much of this, moving between areas served by the certificated airline system, could be accommodated by that system.

Action of this type was called for recently by Senator A. S. Mike Monroney who said:

"It's high time we break this bottleneck by using Government cargo movements as a seed bed for a brand new industry of great prospects and promise —and at the same time ensure the kind of mobility on a world-wide basis that can help guarantee against a shooting war—either limited or atomic."

MAIL VOLUMES ARE INCREASING



Mail Service: Vast improvements in the Postal Service were made possible in 1960 as the airlines made increased capacity and speed available and participated in expansion of non-priority mail by air services to the new states of Alaska and Hawaii.

Recently, the Civil Aeronautics Board commented:

"The carriers have continued to improve service to the public and make expanded mail services available to the Post Office Department. At the same time, the unit price paid to the carriers for the movement of mail by the Department has declined."

". . . the only standard that will be . . . satisfactory."

Total U. S. mail volume carried by the certificated airlines last year was 240,579,000 ton-miles, an increase of 17.4 per cent over 1959. Mail traffic accounted for 4.8 per cent of total traffic carried by the airlines and 3.2 per cent of total revenues.

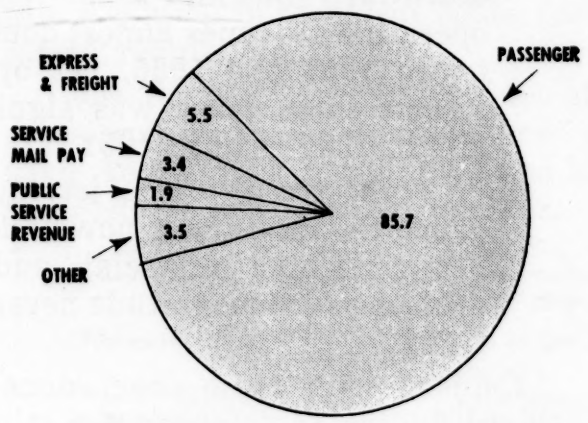
Express Service: Expanded service for air express users resulting from the new partnership agreement between the airlines and the Railway Express Agency showed results as air express traffic gained for the third straight year.

1960 express volume was 58,948,000 ton-miles, up 4.1 per cent over 1959. Express traffic accounts for 1.2 per cent of total airline traffic and slightly under 1 per cent of total revenues.

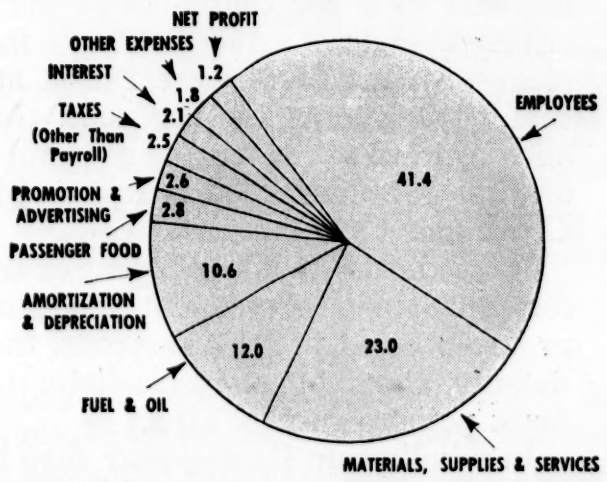
The Jet Fleet: At the end of 1960, the U. S. certificated airlines operated a fleet of 1,908 aircraft. Included were 470 jet-powered planes of which 224 were pure jets and 246 were prop-jets.

THE 1960* AIRLINE DOLLAR

Where the Airline Dollar Came From:

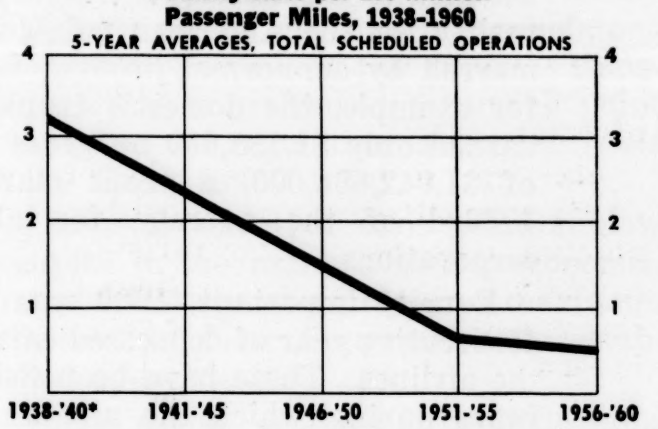


Where the Airline Dollar Went:



* For the 12 month period ending September 30, 1960

AIR SAFETY PROGRESS
Fatality Rate per 100 Million Passenger Miles, 1938-1960
5-YEAR AVERAGES, TOTAL SCHEDULED OPERATIONS



*3 Year Average

Source: Civil Aeronautics Board

This year, the airlines will take delivery of an additional 157 jet-powered planes, consisting of 118 pure jets and 39 turboprops. That will raise the total jet-powered fleet of fixed wing aircraft to 627.

An additional 82 jet planes are scheduled for delivery in the 1962-65 period. Also, 19-turbine-powered helicopters are on order for delivery in 1961-62.

Safety: Last year was the ninth consecutive year in which the fatality rate on the U. S. scheduled air transport system was less than one per 100,000,000 passenger-miles flown.

Actual rate for total domestic and international operations was 0.86 fatalities per 100,000,000 passenger-miles, or about three times better than the fatality rate for passenger automobile travel.

There was a total of nine accidents involving passenger fatalities last year, a year in which the U. S. air carriers performed 3,856,477 scheduled flights (as measured by flight departures). Passenger fatalities totalled 337. That is about 140 less than the average for one week on the U. S. highways.

Nevertheless, by the airlines' own rigid safety standards, the 1960 industry record is not considered satisfactory. Most airlines, of course, operated the year without a fatality. An across-the-board zero fatality rate for the entire industry is the only standard that will be considered satisfactory.

Progress to this end is evident in the long-range trend covering consecutive five-year periods. Thus, in the 1940-44 period, the average rate was 2.45 fatalities per 100,000,000 passenger-miles. But, in the latest five-year period, 1956-60, the record was improved to 0.55.

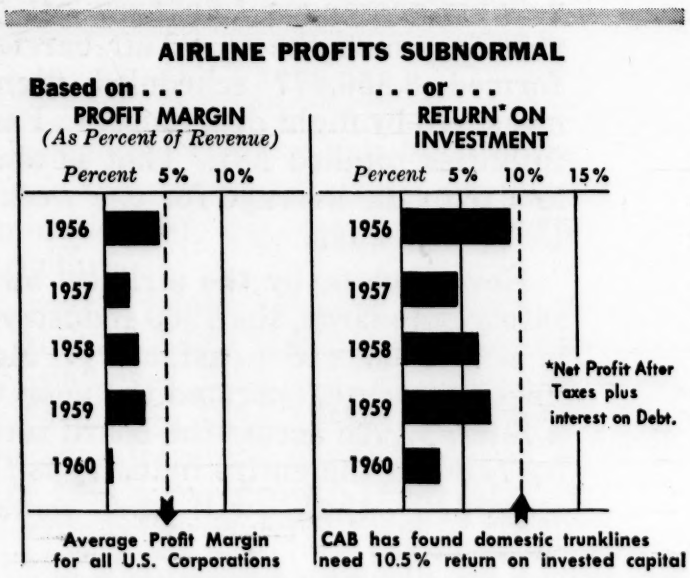
". . . a rapidly worsening profit position."

Earnings: The tremendous progress of the airlines in making the civil jet age a reality for the American public has been marred by subnormal profits. Last year, for example, the domestic trunk airlines earned only $1,188,000 on gross revenues of $1,942,634,000, a profit margin only 1/83rd of the average for all U. S. corporations.

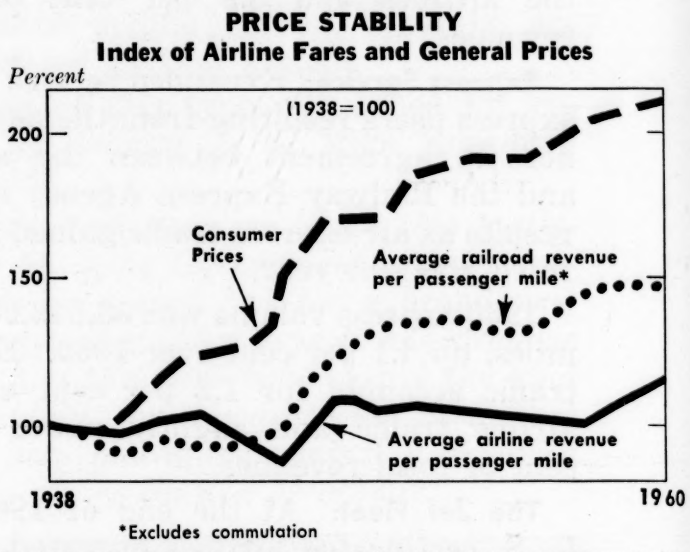
Equally important, 1960 was the fifth consecutive year of depressed earnings for the airlines. These have been five critical years during which the airlines ordered and had to arrange financing for some $3 billion worth of new jet planes. They have been five years during which extensive training and over-all plant modernization was necessary in preparation for the new planes the first of which started in service in late 1958.

In 1954—on the eve of this critical period—the airlines sought Government permission to take steps to guard against the very deterioration in profits that began midway in 1955. The permission was denied.

In the spring of 1956, the Civil Aeronautics Board instituted its General Passenger Fare Investigation, a formal proceeding dealing with trunkline earnings which lasted four and one-half years. In early 1957, the carriers applied for emergency permission to raise fares in view of a rapidly worsening profit position. That permission was denied.



Early in 1958, CAB recognized the need for fare relief and permitted airlines to raise fares 4 per cent plus $1 per ticket, or about 6 per cent in total. In the fall of 1958, CAB permitted the elimination or reduction of certain discounts. These actions were helpful but, it should be noted, they came in the fourth year after the airlines' original request.



Last year, the CAB concluded its general fare investigation. Several of its observations contained in the final decision are worthy of note:

★ "Unfortunately, as contrasted with total revenue growth, airline profits have not only fluctuated but trended downward since mid-1955. While total operating revenues almost doubled between 1951 and 1956, net operating income after taxes was significantly less in 1956 than in 1951."

★ ". . . the transition to jet equipment which the industry is now undergoing has presented financial and other problems of a magnitude never before faced."

Coupled with these conclusions was a Board finding that fares were still not at an adequate level and CAB suggested an increase of 2 per cent plus $1 per ticket, effective July 1, 1960. Thus, in three stages, airline fares were raised approximately a total of 20 per cent. Industry efforts aimed at prevention of profit deterioration were discarded in favor of belated Government "cures".

Nevertheless, while a repeat of this performance in a subsequent modernization program could prove disastrous, there are definite signs of more realistic Government policies in this area.

In winding up its 4½-year fare investigation, for example, the CAB noted the unique characteristics of the airline industry and ruled that airline earnings should be equivalent to a 10.5 per cent average

return on investment for extended periods.

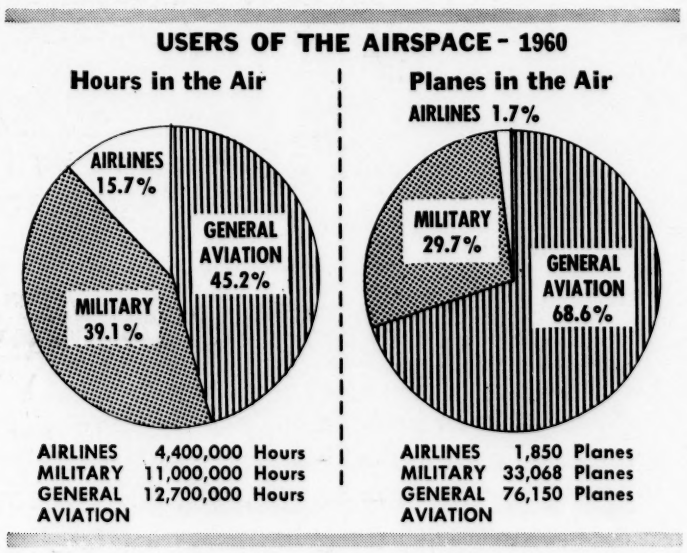
Over the five critical years just passed, the trunk carriers fell far short of reaching that earnings level. Last year, the carriers earned 2.90 per cent on invested capital, or about $116,000,000 less than required to attain the needed return.

One of the important reasons it is necessary to improve this picture was stated this way recently by the new CAB Chairman Alan Boyd:

> *"Today's low (airline) earnings focus attention on another of our immediate problems. Mach 3 (supersonic) is staring us in the face . . . Carrier earnings are the only hope for a substantial private enterprise contribution to supersonic development—and the nation must develop one. Carrier earnings in the years immediately ahead are the only hope that a private enterprise air transport system can absorb the next equipment transition."*

Regulation: The Federal Government has regulated air transportation since 1938. It does so through the Civil Aeronautics Board—in the field of economics and accident investigation—and the Federal Aviation Agency—in technical fields, including safety regulation.

These agencies are the product of Congressional actions expressed first in the Civil Aeronautics Act of 1938 and later in the Federal Aviation Act of 1958.



To date, regulation of air transportation has accomplished much—but also has left much to be desired. Thus, the agencies have, on various occasions, displayed an inability to adjust their thinking and policies to the swiftly changing industry they regulated.

Nevertheless, the ultimate conclusions of CAB in the general fare investigation and recent declarations by Federal officials indicate a more encouraging regulatory policy will prevail in the future. Hopefully, we have arrived at a turning point where Federal regulation is gearing itself to the dynamism of today.

The vital role that civil aviation now occupies in the nation's social, economic, and political structure requires maximum efficiency in these Congressionally established agencies.

There would, of course, be little hope for such maximum efficiency, and the public benefits that depend thereon, were these agencies to be swallowed up in a single Department of Transportation as seems to be proposed year after year.

To link the interests and problems of civil aviation with all its technical, international, and domestic facets to the interests or problems of surface-bound transport companies would not only be impractical but damaging to national interest and counter to the wishes of Congress.

Over a decade ago the U. S. Supreme Court found "no indication that the Congress either entertained or fostered the narrow concept that airborne commerce is a mere outgrowth or overgrowth of surface-bound transport." Rather, it said, "air commerce, whether at home or abroad, soared into a different realm than any that had gone before."

It is the promotion, encouragement, and regulation of such an industry that has been entrusted to CAB and FAA. This country cannot afford the mistake of going backward in this matter—not even for the length of time it might take us to discover and correct our mistake.

Transportation Tax: One of the most important single actions the Government could take to help our nation's entire common carrier transportation system would be to repeal the 10 per cent tax on passenger transportation.

This tax, imposed directly on passengers, was designed in 1941 as a means of discouraging travel on transportation facilities essential to the war effort.

Today, when airlines, railroads, and buses are dependent on traffic growth, the continuation of a tax designed to achieve the opposite result, does just that—it stifles traffic growth.

As one Congressman put it, this tax "continues to burden the public and to threaten the well-being of an industry essential to the national defense." Numerous bills have been introduced at the present session of Congress to repeal this tax on June 30, 1961.

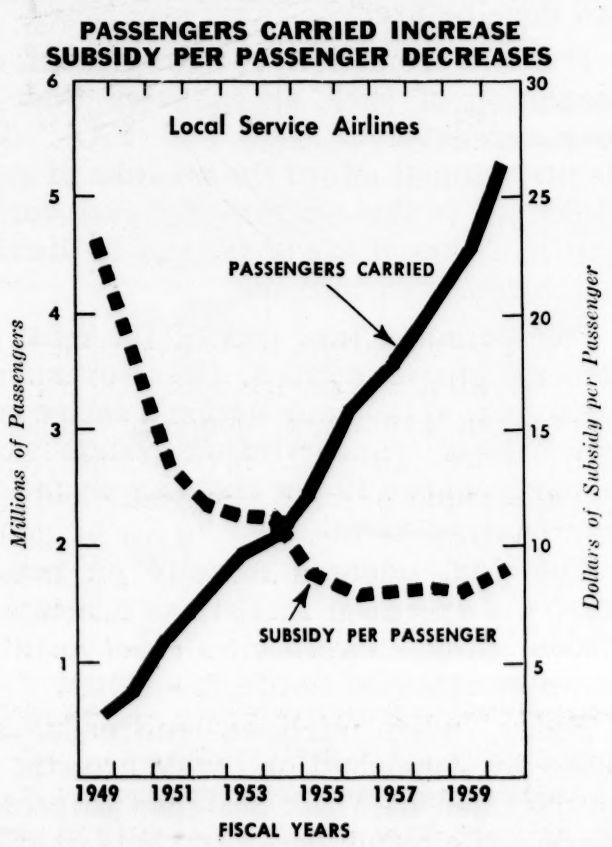
Cut-Rates For Government: Another area where the Government must act to strengthen the common carrier system is in its role as that system's biggest single customer.

Almost 12¢ out of every transportation dollar taken in by the airlines, railroads, steamship and motor carriers combined comes from the Government as a customer. Its impact is about the same as it would be on the automotive industry if the Government purchased three-quarters of a million cars each year.

Yet, while the Government acts to insure fair rates for the public and the carriers, on the one hand, it indulges in cut-rate practices with respect to the traffic it ships via the common carrier system.

When a customer of such size uses its size to chisel transportation rates down to uneconomic levels, it not only is injurious to the companies but affects the prices that must be paid by the general public.

The Air Transport Association has urged that the Executive, Congressional, and regulatory branches of the Government move to correct this problem. Also, we have formally requested the Transportation Association of America, on behalf of the national common carrier system to make this a major undertaking. The aim, simply stated, is to make sure that discrimination in favor of the Government be ended and that rates for Government traffic be made subject to the same machinery applied to rates for the general public.



Government Competition: The Government-owned airline, Military Air Transport Service (MATS), in fiscal 1960, moved 93 per cent of its passengers and 89 per cent of its cargo between areas served by the nation's certificated air carrier system.

Efforts in 1960 to stimulate greater use of the national air transport system in the movement of this traffic were highlighted by CAB's withdrawal of a "blanket exemption" in effect since the Korean War, under which a policy of destructive competitive bidding prevailed.

According to CAB, the effect of that policy over the past ten years "appears to have been the development of what amounts to an overlapping air transport system, operated by MATS, alongside the system authorized by the Board under the Federal Aviation Act to serve the Nation's national defense and commercial needs."

Under CAB's policy, the authority contemplated by the Federal Aviation Act has been reinstated and CAB must pass on bids for MATS business. Meanwhile, there is continued strong Congressional support for transferring more of MATS' airline-type traffic to the certificated airlines. This is to strengthen MATS for its true military role by cutting down its commercial airline type activities—and it is to strengthen the over-all national airlift capability by realistic use of the national air transport system.

Foreign Competition: The relative position of the U. S. - Flag airlines in the air travel market between the U. S. and foreign countries deteriorated sharply in 1960. Although the market consists primarily of U. S. citizens—more than 6 out of every 10—the U. S. airlines share of the market dropped to 51.8 per cent. It had been 56.7 per cent the previous year.

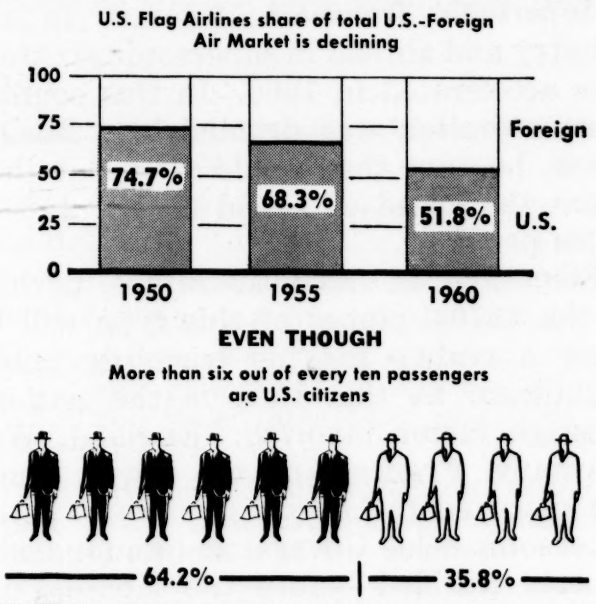
Foreign air carriers, who in 1950 carried about 25 per cent of this traffic, thus

increased their share in 1960 to 48.2 per cent. If this trend continues—and there are no signs that it will be interrupted—1961 will gain the ominous distinction of being the year that the United States surrendered the lead to foreign airlines in the carriage of U. S. international air traffic.

The growth and development of the entire U. S. certificated air carrier system is affected by this development. Under U. S. negotiating policies over the years, not only have more foreign airlines been added in this market but more and more have been given rights to penetrate the domestic U. S. field.

One foreign airline operating from the U. S. west coast to Europe, for example, diverts more than $3 million annually from U. S. transcontinental airlines—an amount greater than the entire net profit of the domestic trunklines in 1960.

PASSENGER TRAFFIC BETWEEN THE UNITED STATES AND FOREIGN COUNTRIES

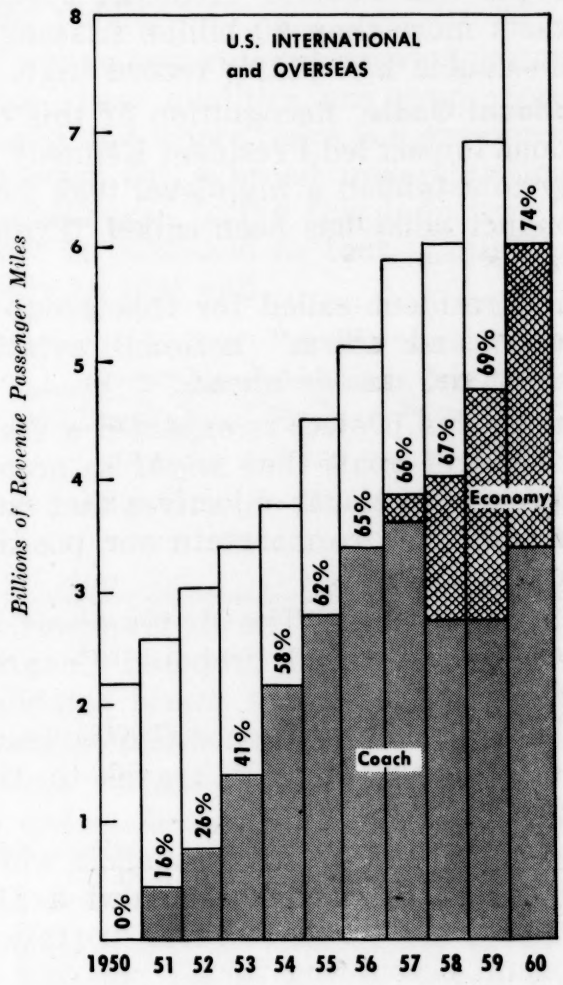


Meanwhile, U. S.-Flag airlines are facing new developments abroad. Airlines of foreign countries, primarily in Europe, are banding together in pools and combines—dividing services and revenues on specific routes. In some cases, air protectionism is becoming evident with some nations party to a pool or combine tending toward restriction of U. S. airline operations.

To avoid a repeat of the deterioration of our merchant marine—the United States Government quickly and intelligently must reappraise its policies in this critical area.

At the same time, this country cannot afford to ignore the significant growth in the Soviet Airline, Aeroflot, which is rapidly stretching its massive system to countries throughout the world. Aeroflot has become a new vanguard for economic and political penetration of non-Iron Curtain countries.

REDUCED FARE TRAFFIC COMPRISES AN EVER-INCREASING PROPORTION OF THE TOTAL



Best information available indicates the Soviet airline has some 1800 transport planes in operation including about 200 jet-powered aircraft. It continues to build up at a rapid pace. Its domestic and international system ranges between 350,000 and 400,000 route miles serving 130 to 140 major airports and perhaps another 335 cities without improved airport facilities.

In less than a decade, it has been transformed into a major element of national prestige and political influence for the Soviets—and there are no indications the Russians are content to remain behind the United States in this vital area.

"... *the potential for growth* ..."

National Impact: Air transportation has become one of the nation's most dynamic forces. It has grown much more rapidly than the general economy. Traffic growth since 1949 is 328 per cent compared to a 51 per cent growth in the Gross National Product.

And the potential for growth in the decade ahead is substantial. CAB has forecast that domestic revenue passenger-miles —which totalled just over 30 billion in 1960—will be about 50 billion by 1965; by 1970, the Federal Aviation Agency forecasts more than 60 billion passenger-miles—double last year's record high.

National Goals: Recognition of this tremendous impact led President Kennedy recently to establish a high-level task force to conduct what has been called "Project Horizon."

The President called for this group to "redefine and affirm" national aviation goals for the decade ahead.

Out of this project is expected a statement—not of goals that *might* be accomplished—but national objectives that *must* be accomplished to maintain our position in world affairs.

U. S. Travel Office: The air transport industry has supported proposed Congressional legislation which would establish, for the first time, a United States travel office to develop tourist travel to this country.

The balance of payments deficit which faced the U. S. in 1960 included a $1.2 billion deficit in travel and transportation, an amount accounting for 27 per cent of the total deficit. This means there was a substantially greater outflow of tourists and tourist dollars than came into the United States.

As Senator Warren Magnuson described it: "Last year, American tourists flocked abroad in the greatest numbers in history, while travel to our country for foreign visitors showed no significant gain".

The air transport industry supports a positive approach to this problem, i.e. maintaining the growth of U. S. tourism abroad while concentrating on steps to develop substantial growth of foreign visitors to this country.

In addition to the broad social and cultural advantages of such a program, this policy promises national economic gains of significant stature.

SELECTED INDICES OF GROWTH

Local Service Airlines

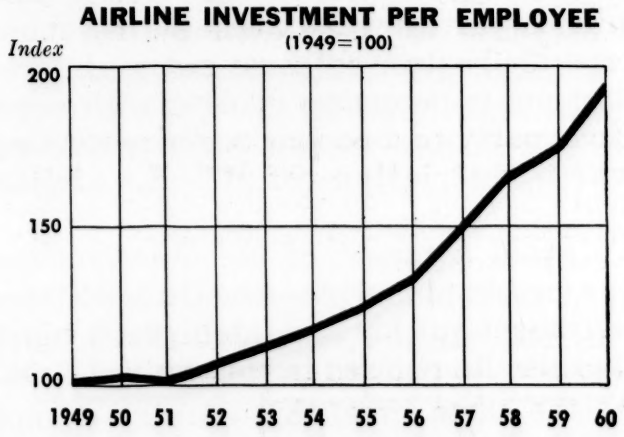
	1950	1960
Total Cities Served	369	547
Cities Served EXCLUSIVELY by Local Service Airlines	195	334
Unduplicate Route Miles	24,769	46,477
Planes in Service	128	302
Plane-miles Flown Daily	90,470	254,000
Seat-miles Available Daily	1,641,500	7,367,000
Employees	4,795	12,295

Supersonic Transport: Interest in this country and abroad in supersonic air travel was accelerated in 1960. In this country, most attention was devoted to a Mach 3 plane, i.e., one that would fly about three times the speed of sound or about 2,000 miles per hour.

Sometime, in the near future, perhaps in the 1970s, planes of this type will become a reality for the traveling public. Significant at this time is the national prestige factor involved. England, West Germany, France, and the Soviet Union are reported to be going forward in the supersonic field. Government and industry experts testified before the House Committee on Science and Astronautics last year that the U. S. can't afford to lose out in this competition.

AIRLINE INVESTMENT PER EMPLOYEE

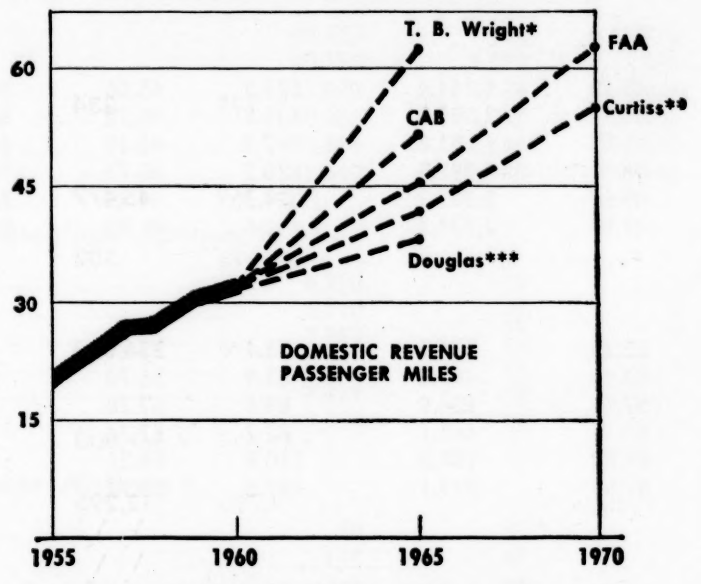
(1949=100)



". . . a record of accomplishment."

From the airline standpoint, substantial improvement in the earnings position is a key factor in how successful U. S. efforts in this area will be.

POTENTIAL FOR FUTURE GROWTH
(5 representative forecasts)

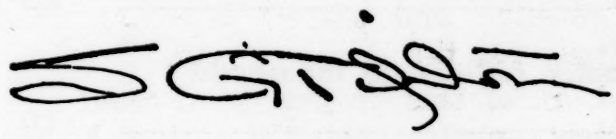


*Chairman of Board, Cornell Aeronautical Laboratory
**Special Asst. to President, Aviation Facilities Planning, 1956-57
***Douglas Aircraft Company

The facts and figures in this report make apparent the progress, problems, and potential of our national air transport system. They represent the basic material necessary for a true perspective of air transport's vital role in our national affairs.

There is a record of accomplishment underlying all of this—one that shows that the airline industry has consistently provided the pioneering vision and courage needed to expand and improve its service to the public.

We have now entered a period, however, where these qualities are even more in demand and where there is a greater need than ever for a broad understanding of the challenges facing this industry. This report is published so that it might contribute to that end.



STUART G. TIPTON

. . . In The Public Interest

FOR AIRLINES TO BE INCREASINGLY SAFE, EFFICIENT, AND ECONOMICAL

In line with the Congressional mandate for the "promotion and continued development" of a sound air transport system and in keeping with objectives and obligations of the United States, decisions, policies, and actions should flow from these basic principles:

1. Civil aviation is an absolutely essential part of the economic, social, and national defense structure of the country.

2. The growth, modernization, and general price stability of commercial air transportation exemplifies qualities now called for on a broad front.

3. Basic responsibility for airline growth and development has been entrusted by Congress to the air carrier companies.

4. Government interest, action, and concern is necessary in areas consistent with maximum growth, opportunity, safety, and progress. Regulation for regulation's sake must be avoided.

5. The self-generating characteristics of air transport service and technology should be preserved and encouraged.

6. Where existing impediments to national objectives — such as the World War II travel tax — can be removed, efforts should be directed to that end. At the same time, new economic burdens should be avoided where inconsistent with the national need for a safe, efficient, and economical airline industry.

7. Where airline equipment and facilities can be utilized for Government traffic they should be made available and so utilized to foster maximum growth of the national air transport system and maximum capability of military units.

8. Air transport's significant role as a prime national element in the shifting tides of world trade should continue to be recognized and utilized.

9. United States international air transport policies should reflect the broadened scope and changing nature of foreign airline activity.

AVAILABLE SERVICE AND UTILIZATION

U. S. Scheduled Airline Industry
(In Millions)

	Available Ton Miles Flown	Revenue Ton Miles Flown	Ton Mile Load Factor (%)	Available Seat Miles Flown	Revenue Passenger Miles Flown	Passenger Load Factor (%)	Revenue Plane Miles Flown
Domestic Trunk Airlines							
1955	3,882.7	2,160.1	55.63	30,001.3	19,217.2	64.05	564.0
1956	4,393.2	2,417.0	55.02	33,752.6	21,643.1	64.12	622.1
1957	5,150.4	2,720.0	52.81	39,838.2	24,499.5	61.50	711.1
1958	5,190.2	2,750.9	53.00	40,695.0	24,435.7	60.05	700.6
1959	5,949.3	3,166.8	53.23	45,793.2	28,127.2	61.42	743.5
1960	6,582.8	3,332.5	50.62	49,153.6	29,233.2	59.47	712.8
Local Service Airlines							
1955	121.9	55.3	45.36	1,161.4	523.3	45.06	50.9
1956	145.6	66.8	45.91	1,385.0	633.2	45.72	59.5
1957	170.7	78.5	46.00	1,653.8	747.3	45.19	67.3
1958	185.4	86.6	46.71	1,793.5	820.2	45.73	72.3
1959	238.5	108.8	45.67	2,309.2	1,024.3	44.35	85.4
1960	282.3	121.2	42.93	2,724.7	1,141.6	41.89	93.3
Intra-Hawaiian Airlines [1]							
1955	16.1	8.4	52.10	134.7	78.1	57.99	4.6
1956	16.0	8.5	53.03	147.9	83.9	56.70	4.6
1957	15.7	9.1	57.96	154.9	89.5	57.78	4.7
1958	18.4	11.3	61.15	143.1	82.7	57.76	4.4
1959	21.1	12.7	59.89	187.2	110.9	59.21	5.3
1960	30.7	17.7	57.65	217.1	127.5	58.72	5.6
Helicopter Airlines (in thousands) [2]							
1955	434	195	44.93	1,708	628	36.77	1,148
1956	567	277	49.03	3,561	1,588	44.59	1,315
1957	1,056	448	42.42	8,049	3,272	40.66	1,604
1958	1,497	591	39.48	11,419	4,885	42.78	1,675
1959	1,759	855	48.61	14,628	7,478	51.12	1,899
1960	2,226	1,054	47.34	18,764	9,475	50.49	2,218
International and Overseas Airlines							
1955	984.6	633.8	64.37	7,012.1	4,410.8	62.90	130.7
1956	1,143.4	741.2	64.82	8,073.1	5,113.2	63.34	146.0
1957	1,292.9	827.0	63.96	9,038.1	5,751.7	63.64	155.7
1958	1,426.6	873.1	61.20	10,057.6	5,974.6	59.40	165.5
1959	1,573.7	1,026.4	65.23	10,474.2	6,894.6	65.83	164.5
1960	1,952.9	1,160.3	59.41	12,978.7	8,137.2	62.69	155.2
Alaskan Airlines							
1955	46.0	29.4	63.87	233.9	110.4	47.20	10.5
1956	66.9	44.8	66.98	284.1	137.0	48.21	11.3
1957	59.4	32.5	55.08	329.7	151.9	46.07	11.5
1958	59.9	32.9	54.89	369.0	163.8	44.39	11.5
1959	72.8	42.2	58.00	414.0	183.0	44.22	12.4
1960	73.8	45.0	60.97	421.9	189.9	45.01	13.2
All-Cargo Airlines							
1955	184.0	135.1	73.41	.....	.....	.....	17.1
1956	321.5	248.8	77.38	.....	.....	.....	23.5
1957	431.7	336.9	78.04	.....	.....	.....	23.3
1958	383.8	319.3	83.20	.....	.....	.....	16.1
1959	422.1	332.7	78.82	.....	.....	.....	16.2
1960	427.2	322.8	75.56	.....	.....	.....	14.6
CONSOLIDATED INDUSTRY							
1955	5,235.7	3,022.2	57.72	38,545.1	24,340.4	63.15	779.0
1956	6,087.1	3,527.4	57.95	43,646.3	27,612.0	63.26	868.4
1957	7,121.5	4,004.4	56.23	51,022.7	31,243.1	61.23	975.3
1958	7,265.7	4,074.7	56.08	53,069.6	31,481.9	59.32	972.1
1959	8,279.3	4,690.4	56.65	59,303.4	36,347.5	61.29	1,029.1
1960	9,351.9	5,000.5	53.47	65,514.7	38,838.9	59.28	996.9

NOTE: Available Ton Miles and Revenue Ton Miles include charter operations; all other items are for scheduled service only.

[1] Has been carried in the past as Territorial Airlines.
[2] Helicopter passenger service began in 1953.

REVENUE TON MILES OF TRAFFIC CARRIED

U. S. Scheduled Airline Industry
(In Thousands of Revenue Ton Miles)

	Passenger [2]	Priority U. S. Mail	Non Priority U. S. Mail [3]	Express	Freight	Charter Flights	Excess Baggage [4]	Total
Domestic Trunklines								
1955	1,825,631	71,859	14,175	49,603	174,017	5,737	19,046	2,160,068
1956	2,056,098	77,788	13,891	49,709	190,592	5,911	23,055	2,417,044
1957	2,327,334	82,057	15,137	42,752	218,432	6,335	27,983	2,720,030
1958	2,321,347	87,809	16,155	45,890	240,510	12,000	27,237	2,750,948
1959	2,672,087	98,485	17,929	53,106	282,473	13,270	29,419	3,166,769
1960	2,777,148	108,059	22,845	55,440	320,949	18,967	29,071	3,332,479
Local Service Airlines								
1955	49,713	928	328	1,403	1,355	1,338	245	55,310
1956	60,156	1,192	344	1,687	1,624	1,520	320	66,843
1957	71,079	1,174	345	1,642	2,082	1,717	471	78,510
1958	78,055	1,330	395	1,801	2,241	2,196	575	86,593
1959	97,514	1,695	504	2,210	3,122	3,060	710	108,815
1960	108,649	2,125	588	2,419	3,847	2,744	799	121,171
Intra-Hawaiian Airlines [1]								
1955	6,250	59	.....	N.A.	1,646	436	20	8,411
1956	6,710	63	2	.....	1,475	236	17	8,503
1957	7,259	63	1	.....	1,536	170	36	9,065
1958	6,611	67	2	.....	1,587	2,965	32	11,264
1959	8,879	75	.....	.....	1,625	2,057	29	12,665
1960	10,155	81	5	.....	1,806	5,605	31	17,683
Helicopter Airlines [5]								
1955	60	90	.....	31	5	.....	3	195
1956	149	89	.....	31	7	.....	1	277
1957	311	92	.....	33	8	3	1	448
1958	463	83	.....	32	6	5	2	591
1959	710	87	.....	41	7	7	3	855
1960	902	92	.....	40	6	10	4	1,054
International and Overseas Airlines [4]								
1955	453,195	52,409	.....	243	90,598	19,701	17,648	633,794
1956	524,369	55,158	.....	.....	109,235	32,652	19,757	741,171
1957	589,510	57,265	.....	.....	123,280	36,188	20,771	827,014
1958	597,326	65,825	.....	.....	128,925	60,817	20,191	873,084
1959	688,521	71,578	10	.....	153,956	91,397	20,980	1,026,442
1960	813,009	80,285	12,102	.....	184,930	48,277	21,649	1,160,252
Alaskan Airlines [6]								
1955	11,868	2,279	.....	.....	7,300	7,773	152	29,372
1956	14,719	2,383	.....	.....	7,948	19,527	241	44,818
1957	16,002	2,695	.....	.....	7,201	6,344	271	32,513
1958	17,290	3,069	35	.....	6,937	5,291	298	32,920
1959	19,389	3,619	10	.....	7,484	11,402	301	42,205
1960	20,106	4,137	131	.....	8,887	11,415	341	45,017
All-Cargo Airlines								
1955	.....	.....	318	.....	107,945	26,796	.....	135,059
1956	.....	381	1,188	1,266	140,420	105,526	.....	248,781
1957	.....	440	1,409	1,638	155,126	178,249	.....	336,862
1958	.....	2,040	621	1,112	121,382	194,104	61	319,320
1959	.....	6,128	161	1,250	140,816	184,226	78	332,659
1960	.....	7,240	2,889	1,049	123,367	188,020	217	322,782
CONSOLIDATED INDUSTRY								
1955	2,346,717	127,630	14,821	51,280	382,866	61,781	37,114	3,022,209
1956	2,662,201	137,054	15,425	52,693	451,301	165,372	43,391	3,527,437
1957	3,011,495	143,786	16,892	46,065	507,665	229,006	49,533	4,004,442
1958	3,021,093	160,222	17,207	48,835	501,586	277,379	48,396	4,074,718
1959	3,487,100	181,667	18,614	56,607	589,483	305,419	51,520	4,690,410
1960	3,729,969	202,019	38,560	58,948	643,792	275,038	52,112	5,000,438

N.A. Not Available.

1 Has been carried in the past as Territorial Airlines.

2 Passenger ton miles for years prior to 1957 were revised to conform with "standard" passenger weights as prescribed by the CAB effective January 1, 1957.

3 See definitions, page 70.

4 Foreign mail carried by International and Overseas and All-Cargo airlines is included in Excess Baggage. Therefore, it is also reflected in Consolidated Industry Excess Baggage data.

5 Helicopter passenger service began in 1953.

6 Express and Freight combined.

OPERATING

U. S. Scheduled Airline Industry

	Passenger	U. S. Mail		Public Service Revenue [1]	Express	Freight	Other [2]	Total
		Priority	Non-Priority					
Domestic Trunk Airlines								
1955	1,021,855	24,230	2,708	3,192	19,405	39,605	22,353	1,133,348
1956	1,142,197	28,937	2,654	2,609	18,101	42,173	26,160	1,262,831
1957	1,287,172	31,002	2,760	1,182	14,667	49,870	32,961	1,419,614
1958	1,362,992	33,039	3,076	2,386	16,140	57,351	38,265	1,513,249
1959	1,632,646	37,159	3,417	.....	19,157	67,026	39,204	1,798,609
1960 P	1,756,439	40,415	4,353	.....	21,785	74,792	44,850	1,942,634
Local Service Airlines								
1955	32,840	1,084	101	20,923	665	556	1,281	57,450
1956	40,166	1,004	102	23,211	775	750	1,704	67,712
1957	47,464	1,108	103	29,651	725	1,049	2,039	82,139
1958	56,488	1,273	90	32,746	809	1,183	2,364	94,953
1959	73,091	1,474	154	42,179	1,019	1,727	3,179	122,823
1960 P	83,448	1,755	159	54,650	1,370	2,127	3,322	146,831
Intra-Hawaiian Airlines								
1955	5,686	48	.....	291	.....	752	337	7,114
1956	6,042	51	1	288	.....	782	266	7,430
1957	6,975	51	2	72	.....	781	479	8,360
1958	7,063	54	.....	109	.....	776	1,391	9,393
1959	9,476	61	1	168	.....	832	1,062	11,600
1960 P	11,196	63	2	.....	.....	953	2,517	14,731
Helicopter Airlines								
1955	208	250	.....	2,710	100	23	64	3,355
1956	438	234	.....	2,833	115	28	63	3,711
1957	968	237	.....	3,567	101	36	123	5,032
1958	1,459	214	.....	4,369	101	31	115	6,289
1959	2,310	227	.....	4,915	132	39	137	7,760
1960 P	3,187	245	.....	4,931	211	41	(14)	8,601

P Preliminary

[1] Prior to October 1, 1953, Public Service Revenues were not reported separately.

REVENUES

(In Thousands of Dollars)

	Passenger	U. S. Mail		Public Service Revenue [1]	Express	Freight	Other [2]	Total
		Priority	Non-Priority					
International and Overseas Airlines								
1955	294,828	25,639	.....	1,583	77	31,853	30,324	384,304
1956	342,553	26,926	.....	8,308	82	36,683	38,113	452,665
1957	377,655	28,365	.....	555	80	41,475	39,818	487,948
1958	385,999	32,655	.....	.....	145	43,802	43,939	506,540
1959	433,098	35,153	.....	.....	93	50,253	46,859	565,456
1960 P	515,253	40,736	1,052	.....	120	56,931	44,428	658,520
Alaskan Airlines								
1955	8,162	2,333	.....	5,618	.....	2,464	3,747	22,324
1956	10,200	2,477	.....	6,241	.....	2,754	7,680	29,352
1957	11,263	2,662	.....	6,369	.....	2,651	4,063	27,008
1958	12,530	2,915	.....	6,839	.....	2,659	3,981	28,924
1959	14,603	3,288	.....	7,473	.....	2,793	5,423	33,580
1960 P	15,463	3,633	20	9,221	.....	3,315	5,029	36,681
All-Cargo Airlines								
1955	.....	60	.....	.....	.....	18,640	8,335	27,035
1956	.....	144	220	.....	447	25,564	26,485	52,860
1957	.....	189	263	.....	545	29,281	55,050	85,328
1958	.....	1,048	128	.....	300	23,349	52,026	76,851
1959	.....	3,154	39	.....	357	28,797	38,781	71,128
1960 P	.....	4,735	43	.....	337	24,930	44,509	74,554
CONSOLIDATED INDUSTRY								
1955	1,363,579	53,644	2,809	34,317	20,247	93,893	66,441	1,634,930
1956	1,541,596	59,773	2,977	43,490	19,520	108,734	100,471	1,876,561
1957	1,731,497	63,614	3,128	41,396	16,118	125,143	134,533	2,115,429
1958	1,826,531	71,198	3,294	46,449	17,495	129,151	142,081	2,236,199
1959	2,165,224	80,516	2,610	54,735	20,665	151,561	134,645	2,610,956
1960 P	2,384,986	91,582	5,629	68,802	23,823	163,089	144,641	2,882,552

2 Other revenues include revenues from excess baggage, foreign mail and charter operations, and incidental revenues.

3 Express and Freight combined.

DISTRIBUTION OF

U. S. Scheduled Airline Industry

	Flying Operations	Maintenance	General Services & Administration: Passenger Service	Aircraft & Traffic Servicing	Promotion & Sales	Administrative	Total G. S. & A.	Depreciation & Amortization	Total Operating Expenses
Domestic Trunk Airlines									
1955	302,591	196,320	72,996	133,274	134,706	68,473	409,449	101,709	1,010,069
1956	340,670	239,530	83,953	152,928	159,366	79,462	475,709	106,321	1,162,230
1957	434,842	270,328	95,505	217,208	157,561	55,164	525,438	146,968	1,377,576
1958	437,515	286,126	101,223	231,109	165,944	56,949	555,226	139,256	1,418,123
1959	505,244	346,389	130,939	275,301	198,782	64,990	670,012	171,729	1,693,374
1960 P	548,123	397,036	150,355	305,674	215,093	74,359	745,482	217,145	1,907,786
Local Service Airlines									
1955	18,080	10,384	2,687	9,563	9,287	4,485	26,022	2,278	56,764
1956	21,616	12,610	3,385	11,187	11,399	5,382	31,353	2,714	68,293
1957	26,509	16,418	4,028	21,160	6,089	4,938	36,215	3,758	82,900
1958	29,267	18,572	4,528	24,047	7,026	5,544	41,146	4,351	93,336
1959	36,831	24,951	6,080	31,188	9,291	6,852	53,411	6,887	122,080
1960 P	42,026	31,263	7,198	36,482	11,594	8,225	63,499	8,275	145,063
Intra-Hawaiian Airlines									
1955	1,942	1,278	245	1,258	1,045	964	3,512	603	7,335
1956	2,033	1,259	252	1,317	1,182	848	3,599	416	7,307
1957	2,212	1,422	278	1,521	1,265	868	3,932	515	8,081
1958	2,504	1,698	413	1,671	1,283	1,022	4,393	661	9,256
1959	3,076	1,933	456	1,948	1,726	1,223	5,353	909	11,271
1960 P	4,066	3,052	629	2,319	2,044	1,335	6,327	1,368	14,813
Helicopter Airlines									
1955	614	871	21	425	180	393	1,019	451	2,955
1956	697	981	21	544	312	496	1,373	605	3,656
1957	1,108	1,381	.....	.....	.....	.....	1,765 [1]	911	5,164
1958	1,416	1,618	.....	.....	.....	.....	1,982 [1]	946	5,962
1959	1,696	2,018	.....	.....	.....	.....	2,362 [1]	1,035	7,111
1960 P	1,934	2,546	.....	.....	.....	.....	2,710	1,192	8,382

P Preliminary.

[1] Detailed expense data not reported.

OPERATING EXPENSES

(In Thousands of Dollars)

	Flying Operations	Maintenance	General Services & Administration: Passenger Service	Aircraft & Traffic Servicing	Promotion & Sales	Administrative	Total G. S. & A.	Depreciation & Amortization	Total Operating Expenses
International & Overseas Airlines									
1955	108,501	58,975	26,773	46,990	61,980	31,291	167,034	31,094	365,604
1956	125,613	72,069	31,053	51,583	70,822	33,808	187,266	34,593	419,541
1957	142,944	72,326	32,519	67,187	70,902	24,631	195,239 [2]	50,359	460,868
1958	155,060	79,892	35,516	72,716	75,759	24,412	210,695 [2]	50,824	496,471
1959	161,300	89,740	42,762	80,503	85,866	27,617	238,125 [2]	58,183	547,348
1960 P	170,994	96,363	46,333	94,276	100,371	27,354	270,148	75,861	613,366
Alaskan Airlines									
1955	7,191	5,273	773	2,701	1,593	1,519	6,586	1,120	21,706 –
1956	9,959	5,744	964	3,702	1,831	1,894	8,391	1,364	27,166 [2]
1957	8,669	6,215	854	2,779	1,042	853	10,065 [2]	1,646	26,595
1958	8,998	6,228	920	3,321	1,068	1,195	10,678 [2]	1,920	27,824
1959	10,600	7,720	1,226	3,641	1,311	1,340	12,380 [2]	2,737	33,437
1960 P	10,367	7,913	1,349	3,795	1,342	1,462	13,185	2,727	34,19
All-Cargo Airlines									
1955	10,635	5,287	267	3,896	2,081	2,103	8,347	2,074	26,343
1956	21,677	11,662	1,614	6,353	3,883	3,454	15,304	3,155	53,879
1957	36,563	18,969	3,618	12,450	4,064	4,395	25,203 [2]	8,998	89,734
1958	31,929	17,903	2,503	8,878	2,612	4,388	19,145 [2]	9,172	78,149
1959	30,461	17,899	1,504	8,510	2,590	4,470	18,405 [2]	7,372	74,137
1960 P	33,635	18,513	1,790	9,658	3,243	4,703	19,826	7,999	79,973
CONSOLIDATED INDUSTRY									
1955	449,554	278,388	103,762	198,107	210,872	109,228	621,969	139,329	1,490,776 [2]
1956	522,265	343,855	121,242	227,614	248,795	125,344	722,995	149,168	1,742,072 [2]
1957	652,847	387,060	136,802	322,305	240,923	90,848	797,855 [2]	213,156	2,050,918
1958	666,689	412,037	145,103	341,742	253,692	93,510	843,265 [2]	207,130	2,129,121
1959	749,208	490,650	182,967	401,091	299,566	106,492	1,000,048 [2]	248,852	2,488,758
1960 P	811,142	556,686	207,654	452,204	333,687	117,438	1,121,180	314,567	2,803,575

[2] Total is greater than sum of individual expense categories since segregation of expenses is not reported by all carriers.

SUMMARY OF

U. S. Scheduled Airline Industry

	Total Operating Revenues	Total Operating Expenses	Net Operating Income	Interest on Long-Term Debt	Other Non-Operating Income (Net)	Income Taxes	Net Profit or Loss [1]	Rate of Return on Investment [2] (%)	Profit Margin on Sales [3] (%)
Domestic Trunk Airlines									
1955	1,133,348	1,010,069	123,279	6,540	16,388	70,024	63,103	11.8	5.6
1956	1,262,831	1,162,230	100,601	9,964	23,917	56,842	57,712	9.4	4.6
1957	1,419,614	1,377,576	42,036	16,201	18,651	23,076	26,988	4.9	1.9
1958	1,513,249	1,418,123	95,126	24,456	20,588	44,723	44,794	6.3	3.0
1959	1,798,609	1,693,374	105,235	32,214	41,721	53,060	61,682	7.3	3.4
1960 P	1,942,634	1,907,786	34,848	43,757	31,756	18,213	1,188	2.9	0.1
Local Service Airlines									
1955	57,450	56,764	686	219	369	484	352	2.7	0.6
1956	67,712	68,293	(581)	376	106	(50)	(801)	(—)	(—)
1957	82,139	82,900	(760)	224	(472)	(51)	(1,153)	(—)	(—)
1958	94,953	93,336	1,617	808	267	394	1,137	7.9	1.2
1959	122,823	122,080	743	1,846	1,158	(177)	232	5.5	0.2
1960 P	146,831	145,063	1,768	2,694	582	281	1,620	7.8	1.1
Intra-Hawaiian Airlines									
1955	7,114	7,335	(221)	106	210	8	(125)	(—)	(—)
1956	7,430	7,307	123	97	(14)	.....	12	3.3	0.2
1957	8,360	8,081	278	109	376	53	267	11.0	3.2
1958	9,393	9,256	137	164	(5)	.....	(115)	1.2	(—)
1959	11,600	11,271	329	289	(11)	(37)	88	5.6	0.8
1960 P	14,731	14,813	(82)	477	33	.....	(521)	.....	.....
Helicopter Airlines									
1955	3,355	2,955	400	11	155	202	342	10.0	10.2
1956	3,711	3,656	55	23	(63)	8	(39)	(—)	(—)
1957	5,032	5,164	(131)	64	19	(55)	(111)	(—)	(—)
1958	6,289	5,962	327	94	15	113	491	11.4	7.8
1959	7,760	7,111	649	78	239	309	501	10.7	6.5
1960 P	8,601	8,382	219	43	35	92	150	3.3	1.7

P Preliminary. () Denotes reverse item.

[1] Net Profit or Loss for 1957, 1958, 1959 and 1960 is shown after "Special Items," which are not included in the detail. Therefore, the items do not add to the profit figures shown.

PROFIT OR LOSS

(In Thousands of Dollars)

	Total Operating Revenues	Total Operating Expenses	Net Operating Income	Interest on Long-Term Debt	Other Non-Operating Income (Net)	Income Taxes	Net Profit or Loss [1]	Rate of Return on Investment [2] (%)	Profit Margin on Sales [3] (%)
International and Overseas Airlines									
1955	384,304	365,604	18,700	1,700	6,754	10,320	13,434	6.3	3.5
1956	452,665	419,541	33,124	3,000	8,169	17,792	20,501	8.2	4.5
1957	487,948	460,868	27,080	4,882	8,619	13,252	19,520	7.8	4.0
1958	506,540	496,471	10,069	5,759	8,090	5,427	6,548	3.2	1.3
1959	565,456	547,348	18,108	8,407	13,305	10,092	12,917	4.7	2.3
1960 P	658,520	613,366	45,154	16,295	5,928	18,905	15,105	5.4	2.3
Alaskan Airlines									
1955	22,324	21,706	518	76	228	334	436	8.3	2.0
1956	29,352	27,166	2,186	222	(98)	870	996	15.1	3.4
1957	27,008	26,595	413	362	729	121	900	11.1	3.3
1958	28,924	27,824	1,100	418	350	673	391	5.7	1.4
1959	33,580	33,437	143	652	524	313	(298)	2.2	(—)
1960 P	36,681	34,192	2,489	547	211	792	866	8.1	2.4
All-Cargo Airlines									
1955	27,035	26,343	692	561	1,132	80	1,163	9.4	4.4
1956	52,860	53,879	(1,019)	488	4,539	1,210	1,822	7.0	3.4
1957	85,328	89,734	(4,406)	1,526	4,022	285	(2,207)	(—)	(—)
1958	76,851	78,149	(1,298)	1,672	1,655	1,351	(3,726)	(—)	(—)
1959	71,128	74,137	(3,009)	1,610	2,823	1,819	(3,615)	(—)	(—)
1960 P	74,554	79,973	(5,419)	1,806	(1,711)	(7)	(8,829)	(—)	(—)
CONSOLIDATED INDUSTRY									
1955	1,634,930	1,490,776	144,154	9,213	25,236	81,452	78,725	10.8	4.8
1956	1,876,561	1,742,072	134,489	14,170	36,556	76,672	30,203	8.8	4.3
1957	2,115,429	2,050,918	64,511	23,368	31,665	36,683	44,202	5.1	2.1
1958	2,236,199	2,129,121	107,078	33,215	30,960	52,681	49,520	5.2	2.2
1959	2,610,956	2,488,758	122,198	45,096	54,784	65,379	71,507	6.3	2.7
1960 P	2,882,552	2,803,575	78,977	65,619	36,834	38,276	9,579	3.3	0.3

[2] Net income before interest and after taxes as percent of average net worth and long-term debt.

[3] Profit as percent of revenues.

ASSETS, LIABILITIES AND

U. S. Scheduled Airline Industry

	1955	1956	1957	1958	1959	(Sept. 30) 1960
Domestic Trunk Airlines [1]						
Assets						
Current Assets	436,609	439,827	457,611	496,756	633,791	657,704
Investments and Special Funds	47,405	146,147	127,943	184,163	132,781	122,846
Flight Equipment	890,095	1,097,044	1,363,767	1,531,141	1,898,778	2,197,525
Reserve for Depreciation and Maintenance [3]	478,482	553,793	639,019	756,023	832,707	879,167
Airworthiness Reserve	.....	.....	.....	.....	.....	16,611
Ground Property and Equipment	154,104	180,613	206,452	237,840	279,017	309,230
Reserve for Depreciation	77,622	89,217	101,001	115,769	132,551	147,618
Other Property	28,402	41,359	49,667	100,445	105,920	84,789
Deferred Charges	9,459	13,264	23,541	28,566	55,342	70,020
Other Assets	1,175	6,308	.....	.....	.....	.....
Total Assets	1,011,145	1,281,552	1,488,961	1,707,119	2,140,371	2,398,718
Liabilities and Equity						
Current Liabilities	276,839	333,876	328,844	332,788	474,009	524,282
Long-Term Debt	198,916	324,071	469,486	588,730	804,579	961,491
Other Non-Current Liabilities	.....	.....	1,224	19,712	2,015	31,087
Operating Reserves	8,365	10,490	.....	.....	.....	.....
Deferred Credits	22,886	37,646	51,480	78,818	114,564	133,331
Stockholders' Equity—Net of Treasury Stock	504,139	575,469	637,927	687,071	745,204	748,527
Preferred Stock	29,789	16,592	15,805	24,000	19,071	18,883
Common Stock	80,172	88,555	108,502	111,473	116,627	118,505
Other Paid-In Capital	141,839	178,058	215,292	236,105	262,521	274,611
Retained Earnings	252,339	291,872	298,328	315,493	347,420	337,147
Total Liabilities and Equity	1,011,145	1,281,552	1,488,961	1,707,119	2,140,371	2,398,718
Local Service Airlines						
Assets						
Current Assets	12,970	14,873	16,512	20,003	29,897	34,543
Investments and Special Funds	950	1,438	3,028	2,894	2,055	2,209
Flight Equipment	21,451	26,105	32,949	46,308	67,202	75,740
Reserve for Depreciation and Maintenance [3]	11,096	12,628	16,825	20,445	25,090	23,872
Airworthiness Reserve	.....	.....	.....	.....	.....	4,862
Ground Property and Equipment	5,122	5,795	6,544	7,594	9,869	10,814
Reserve for Depreciation	2,555	2,949	3,556	4,119	4,870	5,548
Other Property	682	3,692	607	1,518	1,931	1,014
Deferred Charges	885	1,564	1,931	2,650	3,574	4,283
Other Assets	2	35	.....	.....	.....	.....
Total Assets	28,411	37,925	41,190	56,403	84,568	94,321
Liabilities and Equity						
Current Liabilities	12,461	17,431	22,002	25,134	34,214	37,977
Long-Term Debt	4,013	7,800	8,656	18,106	31,062	40,773
Other Non-Current Liabilities	.....	.....	205	363	4,072	1,517
Operating Reserves	783	1,138	.....	.....	.....	.....
Deferred Credits	21	303	264	220	293	332
Stockholders' Equity—Net of Treasury Stock	11,133	11,253	10,063	12,580	14,927	13,722
Preferred Stock	412	920	163	163	351	163
Common Stock	6,345	5,871	6,776	7,279	8,055	8,305
Other Paid-In Capital	4,324	4,891	4,863	5,733	7,180	7,183
Retained Earnings	52	(429)	(1,739)	(595)	(585)	(1,856)
Total Liabilities and Equity	28,411	37,925	41,190	56,403	84,568	94,321

1 Balance sheet data for domestic trunk airlines reflect their international as well as domestic operations. They are not included in International and Overseas.

2 Has been carried in the past as Territorial Airlines.

3 Does not include maintenance reserve in 1960.

STOCKHOLDERS' EQUITY

(In Thousands of Dollars)

	1955	1956	1957	1958	1959	(Sept. 30) 1960
Intra-Hawaiian Airlines [2]						
Assets						
Current Assets	1,068	1,241	1,964	2,102	3,649	3,685
Investments and Special Funds	19	15	113	13	299	63
Flight Equipment	5,744	6,057	5,932	7,786	11,134	14,341
Reserve for Depreciation and Maintenance [3]	2,839	2,930	3,230	3,735	4,104	3,599
Airworthiness Reserve	.....	.....	.....	.....	.....	1,557
Ground Property and Equipment	1,177	1,276	1,354	1,501	1,777	1,948
Reserve for Depreciation	749	847	945	1,043	1,147	1,248
Other Property	41	17	133	77	144	220
Deferred Charges	180	169	182	633	859	1,370
Other Assets	.....	.....	.....	.....	.....	.....
Total Assets	4,641	4,998	5,503	7,334	12,611	15,223
Liabilities and Equity						
Current Liabilities	1,329	1,520	2,011	2,884	2,619	3,948
Long-Term Debt	1,835	1,702	1,635	2,681	6,164	7,762
Other Non-Current Liabilities	.....	.....	.....	.....	.....	.....
Operating Reserves	20	41	.....	.....	.....	.....
Deferred Credits	1	68	23	2	59	142
Stockholders' Equity—Net of Treasury Stock	1,456	1,667	1,834	1,767	3,769	3,371
Preferred Stock	.....	.....	.....	.....	1,625	1,622
Common Stock	1,981	1,981	1,981	1,287	1,304	1,307
Other Paid-In Capital	874	832	832	1,530	1,791	1,792
Retained Earnings	(1,399)	(1,146)	(979)	(1,050)	(951)	(1,350)
Total Liabilities and Equity	4,641	4,998	5,503	7,334	12,611	15,223
Helicopter Airlines						
Assets						
Current Assets	2,385	2,307	2,168	2,998	3,316	3,352
Investments and Special Funds	321	290	27	54	164	510
Flight Equipment	2,508	3,878	5,170	5,023	5,487	5,774
Reserve for Depreciation and Maintenance [3]	1,313	1,645	2,336	1,621	2,344	2,815
Airworthiness Reserve	.....	.....	.....	.....	.....	153
Ground Property and Equipment	312	576	777	825	893	927
Reserve for Depreciation	137	197	311	396	496	560
Other Property	14	71	1	4	55	27
Deferred Charges	163	196	302	429	481	513
Other Assets	.....	.....	.....	.....	.....	.....
Total Assets	4,253	5,476	5,798	7,316	7,556	7,575
Liabilities and Equity						
Current Liabilities	591	735	961	1,804	2,020	1,963
Long-Term Debt	87	817	1,033	1,319	696	354
Other Non-Current Liabilities	.....	.....	.....	1	1	47
Operating Reserves	31	45	.....	.....	.....	.....
Deferred Credits	25	69	109	6	152	244
Stockholders' Equity—Net of Treasury Stock	3,519	3,810	3,695	4,186	4,687	4,967
Preferred Stock	.....	.....	.....	.....	.....	.....
Common Stock	677	702	734	771	771	946
Other Paid-In Capital	2,201	2,435	2,546	2,685	2,686	2,644
Retained Earnings	641	673	415	730	1,230	1,377
Total Liabilities and Equity	4,253	5,476	5,798	7,316	7,556	7,575

ASSETS, LIABILITIES AND

U. S. Scheduled Airline Industry

	1955	1956	1957	1958	1959	(Sept. 30) 1960
International and Overseas Airlines [1]						
Assets						
Current Assets	109,019	111,560	102,202	116,391	147,151	185,719
Investments and Special Funds	33,230	37,987	52,992	93,310	110,962	64,377
Flight Equipment	216,737	265,785	276,758	306,428	407,448	539,247
Reserve for Depreciation and Maintenance [3]	99,787	114,074	132,185	149,995	173,881	189,376
Airworthiness Reserve	.....	.....	.....	.....	.....	9,134
Ground Property and Equipment	29,595	31,813	34,351	35,784	43,619	50,301
Reserve for Depreciation	18,424	18,614	20,741	22,348	23,943	26,426
Other Property	2,719	2,450	4,239	5,585	6,990	6,335
Deferred Charges	3,766	4,440	4,413	9,573	18,112	26,990
Other Assets	.....	.....	.....	.....	.....	.....
Total Assets	276,855	321,347	322,029	394,728	536,458	648,033
Liabilities and Equity						
Current Liabilities	80,041	92,352	87,424	65,298	108,491	133,481
Long-Term Debt	60,481	83,406	85,653	167,234	257,320	324,144
Other Non-Current Liabilities	.....	.....	1,011	775	1,486	2,286
Operating Reserves	3,319	3,584	.....	.....	.....	.....
Deferred Credits	5,846	6,058	6,648	8,445	9,839	25,627
Stockholders' Equity—Net of Treasury Stock	127,168	135,947	141,293	152,976	159,322	162,495
Preferred Stock	150	.....	.....	.....	.....	.....
Common Stock	13,622	13,792	16,310	15,462	16,970	17,089
Other Paid-In Capital	63,120	63,460	62,129	74,296	75,278	75,183
Retained Earnings	50,276	59,119	62,854	63,218	68,610	71,791
Total Liabilities and Equity	276,855	321,347	322,029	394,728	536,458	648,033
Alaskan Airlines						
Assets						
Current Assets	5,600	7,129	7,682	8,271	7,889	9,694
Investments and Special Funds	248	532	957	448	339	738
Flight Equipment	6,906	11,126	13,668	16,438	20,585	19,474
Reserve for Depreciation and Maintenance [3]	4,981	5,539	6,080	6,601	7,666	7,398
Airworthiness Reserve	.....	.....	.....	.....	.....	1,583
Ground Property and Equipment	3,808	4,201	4,843	5,009	5,220	5,391
Reserve for Depreciation	1,531	1,808	2,138	2,417	2,600	2,760
Other Property	163	400	313	2,355	358	232
Deferred Charges	358	422	624	590	579	563
Other Assets	138	134	.....	.....	.....	.....
Total Assets	10,709	16,597	19,869	24,093	24,704	24,351
Liabilities and Equity						
Current Liabilities	4,002	6,170	7,084	8,035	8,748	9,328
Long-Term Debt	765	3,360	4,942	7,565	7,640	5,683
Other Non-Current Liabilities	.....	.....	25	19	89	319
Operating Reserves	457	276	.....	.....	.....	.....
Deferred Credits	200	42	104	282	141	53
Stockholders' Equity—Net of Treasury Stock	5,285	6,749	7,714	8,192	8,086	8,968
Preferred Stock	.....	.....	.....	829	248	247
Common Stock	2,950	3,152	3,315	2,943	3,497	3,601
Other Paid-In Capital	3,605	3,613	3,629	3,655	3,694	3,695
Retained Earnings	(1,270)	(16)	770	765	659	1,444
Total Liabilities and Equity	10,709	16,597	19,869	24,093	24,704	24,351

1 Balance sheet data for domestic trunk airlines reflect their international as well as domestic operations. They are not included in International and Overseas.

2 Has been carried in the past as Territorial Airlines.

3 Does not include maintenance reserve in 1960.

STOCKHOLDERS' EQUITY

(As of Sept. 30, 1960, In Thousands of Dollars)

	1955	1956	1957	1958	1959	(Sept. 30) 1960
All-Cargo Airlines						
Assets						
Current Assets	11,716	21,224	19,589	20,152	20,440	14,940
Investments and Special Funds	2,850	17,244	4,629	3,337	20,522	29,531
Flight Equipment	24,143	31,540	65,449	55,702	59,118	47,283
Reserve for Depreciation and Maintenance [3]	7,575	9,188	17,500	17,522	22,332	18,664
Airworthiness Reserve	.....	.....	.....	.....	.....	1,388
Ground Property and Equipment	2,753	4,666	5,578	4,499	4,214	4,134
Reserve for Depreciation	1,354	1,833	2,382	2,257	2,378	2,336
Other Property	399	3,028	2,682	4,533	701	1,674
Deferred Charges	410	2,706	5,122	4,963	2,233	1,833
Other Assets	140	281	.....	.....	.....	.....
Total Assets	33,482	69,668	83,167	73,407	82,518	77,007
Liabilities and Equity						
Current Liabilities	10,759	19,301	25,991	22,500	22,001	17,717
Long-Term Debt	7,598	16,813	25,121	17,509	28,247	37,375
Other Non-Current Liabilities	.....	.....	449	1,900	1,461	929
Operating Reserves	1,808	2,311	.....	.....	.....	.....
Deferred Credits	235	2,277	3,257	3,325	3,030	2,459
Stockholders' Equity—Net of Treasury Stock	13,082	28,966	28,349	28,173	27,779	18,527
Preferred Stock	1,211	1,441	1,437	1,437	1,193	991
Common Stock	5,466	6,863	8,237	8,901	10,303	10,626
Other Paid-In Capital	4,304	14,341	15,701	19,257	22,269	20,381
Retained Earnings	2,101	6,321	2,974	(1,422)	(6,077)	(13,466)
Total Liabilities and Equity	33,482	69,668	83,167	73,407	82,518	77,007
CONSOLIDATED INDUSTRY						
Assets						
Current Assets	579,367	598,161	607,728	666,673	846,133	909,637
Investments and Special Funds	85,023	203,653	189,689	284,219	267,122	220,274
Flight Equipment	1,167,584	1,441,535	1,763,693	1,968,826	2,469,752	2,899,384
Reserve for Depreciation and Maintenance [3]	606,073	699,797	817,175	955,942	1,068,124	1,124,891
Airworthiness Reserve	.....	.....	.....	.....	.....	35,288
Ground Property and Equipment	196,871	228,940	259,899	293,052	344,609	382,745
Reserve for Depreciation	102,372	115,465	131,074	148,349	167,985	186,496
Other Property	32,420	51,017	57,642	114,517	116,099	94,291
Deferred Charges	15,221	22,761	36,115	47,404	81,180	105,572
Other Assets	1,455	6,758	.....	.....	.....	.....
Total Assets	1,369,496	1,737,563	1,966,517	2,270,400	2,888,786	3,265,228
Liabilities and Equity						
Current Liabilities	386,022	471,385	474,317	458,443	652,102	728,696
Long-Term Debt	273,695	437,969	596,526	803,144	1,135,708	1,377,582
Other Non-Current Liabilities	.....	.....	2,914	22,770	9,124	36,185
Operating Reserves	14,783	17,885	.....	.....	.....	.....
Deferred Credits	29,214	46,463	61,885	91,098	128,078	162,188
Stockholders' Equity--Net of Treasury Stock	665,782	763,861	830,875	894,945	963,774	960,577
Preferred Stock	31,562	18,953	17,405	26,429	22,488	21,906
Common Stock	111,213	120,916	145,855	148,116	157,527	160,379
Other Paid-In Capital	220,267	267,630	304,992	343,261	375,419	385,489
Retained Earnings	302,740	356,394	362,623	377,139	410,306	395,087
Total Liabilities and Equity	1,369,496	1,737,563	1,966,517	2,270,400	2,888,786	3,265,228

REVENUE PASSENGERS CARRIED

U. S. Scheduled Airline Industry
(For Selected Years, In Thousands of Passengers)

	1939	1949	1951	1952	1953	1954	1955	1956	1957 [2]	1958 [2]	1959 [2]	1960 [2]
Domestic Trunk Airlines	1,713	14,021	20,621	22,759	26,137	29,526	34,511	37,598	40,270	39,513	44,489	45,199
Local Service Airlines	.....	678	1,481	1,736	2,032	2,423	2,897	3,453	3,943	4,265	5,214	5,591
Intra-Hawaiian Airlines	22	382	550	515	553	561	591	627	589	572	755	857
Helicopter Airlines	.....	.....	.....	.....	1	9	29	62	148	228	366	490
International and Overseas Airlines	129	1,520	2,038	2,362	2,682	2,888	3,376	3,888	4,065	4,176	4,707	5,202
Alaskan Airlines [1]	n.a.	122	157	194	220	225	264	315	309	313	344	370
TOTAL SCHEDULED AIRLINE INDUSTRY	1,864	16,723	24,847	27,566	31,625	35,632	41,623	45,943	49,339	49,067	55,875	57,709
AVERAGE LENGTH OF HAUL (Statute Miles)												
Domestic Trunk Airlines	397	469	495	533	547	550	557	576	608	618	632	647
International and Overseas Airlines	557	1,351	1,275	1,278	1,261	1,296	1,307	1,315	1,415	1,429	1,465	1,564

[1] Alaskan data for 1949 include charter flights. 1939 not available.

[2] Beginning in 1957 passengers were reported on a basis which yielded slightly lower figures than the basis used in prior years. This accounts in part for the typical increase of average length of haul in 1957 as compared to 1956.

AVERAGE REVENUE PER PASSENGER MILE

Intercity Common Carriers
(For Selected Years, In Cents per Mile)

	1939	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
Domestic Scheduled Airlines [1]													
Coach or Tourist	.....	3.96	4.10	4.45	4.18	4.13	4.34	4.32	4.29	4.25	4.52	4.63	5.01
All Services	5.28	5.75	5.54	5.59	5.54	5.43	5.37	5.32	5.28	5.25	5.58	5.83	6.01
International Scheduled Airlines													
Coach or Tourist	.....	.....	.....	.....	.....	5.77	5.83	n.a.	n.a.	5.77	5.66	5.52	5.57
All Services	8.57	7.72	7.28	7.13	7.04	6.88	6.79	6.68	6.70	6.57	6.51	6.44	6.34
Railroads, Class I [2]													
First Class	2.33	3.14	3.25	3.27	3.35	3.38	3.35	3.31	3.39	3.68	3.75	3.84	3.84
Coach	1.80	2.41	2.47	2.47	2.53	2.53	2.50	2.47	2.56	2.71	2.76	2.77	2.77
Intercity Motor Buses, Class I	1.55	1.85	1.89	1.95	2.03	2.06	2.08	2.06	2.13	2.29	2.42	2.56 [3]	2.61 [3]

[1] Trunk airlines, preliminary.

[2] 10 months 1960. Excludes commutation. Does not include payments to Pullman Company for seat, berth, etc.

[3] ATA estimate.

n.a. Not available.

TREND OF REVENUE PASSENGER MILES BY CLASS OF SERVICE

U. S. Scheduled Airlines
(In Millions)

	Domestic *			International and Overseas			
	Coach	First Class	Total	Economy	Tourist	First Class	Total
1951	1,278	9,223	10,501	.....	416	2,196	2,612
1952	2,356	10,104	12,460	.....	803	2,257	3,060
1953	3,719	10,968	14,687	.....	1,426	2,014	3,440
1954	5,321	11,374	16,695	.....	2,202	1,597	3,799
1955	6,716	13,024	19,740	.....	2,796	1,692	4,488
1956	8,074	14,202	22,276	.....	3,377	1,836	5,213
1957	9,510	15,736	25,246	203	3,636	2,017	5,856
1958	10,076	15,180	25,256	1,343	2,758	2,023	6,124
1959	12,304	16,847	29,151	2,130	2,757	2,177	7,064
1960	14,417	15,957	30,374	3,037	3,162	2,107	8,306

* Trunkline and Local Service

DOMESTIC INTERCITY PASSENGER MILES

(For Selected Years, In Millions)

	1939	1949	1955	1956	1957	1958	1959	1960
Railroad Travel: [1]								
First Class	7,527	9,349	6,440	6,275	5,185	4,249	3,773	3,650 [5]
Coach	11,180	20,310	17,329	17,105	16,365	14,230	13,749	13,200 [5]
Air Travel: [2]								
First Class	654	6,454	13,025	14,202	15,736	15,180	16,847	15,957
Coach	.....	251	6,716	8,074	9,510	10,076	12,304	14,418
Motor Bus Travel [3]	9,100	22,411	16,562	16,409	16,377	15,083	14,400 [5]	14,400 [5]
Total Common Carriers [6]	28,461	58,775	60,072	62,065	63,173	58,818	61,073	61,625
Airline Share of Total	2.3	11.4	32.9	35.9	40.0	42.9	47.7	49.3
Private Automobile, Intercity [4]	234,700	376,313	585,800	617,700	644,800	629,496	659,435	660,000 [5]
Total Common Carrier and Auto	263,161	435,088	645,872	679,765	707,973	688,314	720,508	721,625
Airline Share of Total Intercity Travel	0.2	1.5	3.1	3.3	3.6	3.7	4.0	4.2

1 I.C.C., Statistics of Railways in the United States.
2 1939, CAB, Annual Airline Statistics; 1949, CAB, Recurrent Reports on Traffic Statistics; 1955-1960, Trunk and Local Service Airlines.
3 1939, I.C.C. Statement No. 531, Jan. 1953; 1949-1957, I.C.C. Transport Economics, Jan. 1960, Class I, II and III Interstate Operators.
4 1939, NAMBO, Bus Facts, 20th Edition; 1949-1956, I.C.C. Transport Economics, May 1956 and Dec. 1959, Annual Reports of I.C.C.
5 Estimated.
6 Scheduled services.

AIRCRAFT OPERATIONS AT FAA AIRPORT TOWERS

1950-1960 (In Thousands)

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
Type of Flight Operation											
Military	2,384	2,852	2,983	3,712	4,409	4,957	5,472	5,910	5,565	4,545	3,784
General Aviation	9,585	9,618	7,965	7,719	8,015	8,540	10,021	12,129	14,037	15,008	14,826
Air Carrier	4,002	4,556	4,866	5,384	5,521	5,983	6,553	7,112	6,998	7,353	7,164
Total	15,971	17,026	15,814	16,815	17,945	19,480	22,046	25,151	26,600	26,906	25,774
% Air Carrier of Total	25.1	26.8	30.8	32.0	30.8	30.7	29.7	28.3	26.3	27.3	27.8

Air Carriers include scheduled and non scheduled operations. Each landing is counted as an operation as is also each take off.

COMPARATIVE TRANSPORT SAFETY RECORD

Passenger Fatality Rate per 100,000,000 Passenger Miles *(For Selected Years)*

	1939	1949	1952	1953	1954	1955	1956	1957	1958	1959	1960
Domestic Scheduled Airlines [1]											
Fatalities	9	93	46	86	16	156	143	30	113	211	336
Rate	1.20	1.39	.37	.59	.10	.79	.64	.12	.45	.72	1.10
International and Overseas Scheduled Airlines [2]											
Fatalities	10	4	94	2	0	2	9	40	11	59	1
Rate	12.80	.19	2.98	.06	.....	.04	.17	.67	.18	.86	0.01
Total U. S. Scheduled Airlines											
Fatalities	19	97	140	88	16	158	152	70	124	270	337
Rate	2.28	1.00	0.86	0.46	0.07	0.62	0.50	0.20	0.38	0.71	0.86
Motor Buses											
Fatalities	[3]	130	120	100	60	90	80	90	120	100	n.a.
Rate	[3]	.23	.21	.18	.11	.18	.16	.17	.24	.18	n.a.
Railroad Passenger Trains											
Fatalities	32	29	14	50	23	19	57	17	62	12	32 [4]
Rate	.14	.08	.04	.16	.08	.07	.20	.07	.27	.05	.15 [4]
Passenger Autos and Taxis											
Fatalities	16,300	17,700	23,300	23,900	22,700	25,100	26,600	25,600	24,200	24,800	n.a.
Rate	3.7	2.7	3.0	2.9	2.7	2.7	2.7	2.6	2.3	2.3	n.a.

[1] Alaskan and Hawaiian data included in Domestic beginning in 1959.
[2] Alaska data not included in 1939.
[3] Motor Bus statistics in 1939 included in Passenger Autos and Taxis.
[4] Preliminary
n.a. Not Available

POST OFFICE PROFIT ON DOMESTIC AIRMAIL

Fiscal Year	Post Office Receipts, Domestic Airmail Postage (000)	Payment to Airlines for Domestic Airmail Service [1] (000)	Other Post Office Expenses, Domestic Airmail [2] (000)	Post Office Profit on Domestic Airmail (000)
1950	$ 74,120	$63,639	$ 45,983	($35,502)
1955	142,571	42,780	79,524	20,267
1956	150,938	44,304	88,818	17,816
1957	153,189	45,913	91,607	15,669
1958	151,236	46,858	96,040	8,338
1959	173,979	55,571	96,953	21,455
1960	180,317	59,797	101,537	18,983

[1] Payments to domestic and U. S.-Flag international airlines for hauling domestic airmail within continental United States and to off-shore states or territories. This is a Post Office allocation.
[2] Cost of postal services other than air transport of domestic airmail. Includes relatively small payments to surface carriers for hauling airmail and payments to airlines for hauling classes of mail other than airmail.

Source: U. S. Post Office Department, "Cost Ascertainment Report," for years shown.

AIRCRAFT OWNED AND ON ORDER

By U. S. Scheduled Airline Industry
(For Selected Years)

Manufacturer	Model	1939	1949	1952	1956	1959	1960	New aircraft on order for delivery in: 1961	1962
Armstrong-Whitworth:	Argosy (Turboprop)	....	....	....	....	....	1	6	....
Boeing:	247D, 307B, 314	45	5	....	....	....	....	....	....
	377	....	35	44	34	21	3	....	....
	B707 (Jet)	....	....	....	....	66	93	9	....
	B720 (Jet)	....	....	....	....	....	21	50	11
	B727 (Jet)	....	....	....	....	....	....	....	60 [1]
Canadair:	CL44 (Turboprop)	....	....	....	....	....	....	17	....
Convair:	240	....	112	113	100	46	51	....	....
	340	....	....	8	123	122	117	....	....
	440	....	....	....	19	36	31	....	....
	540 (Turboprop)	....	....	....	....	1	10	....	....
	600 (Jet)	....	....	....	....	....	....	15	10
	880 (Jet)	....	....	....	....	....	29	11	....
Curtiss:	C-46	....	2	75	94	66	42	....	....
Douglas:	DC-2	56	....	....	....	....	....	....	....
	DC-3	147	449	419	356	305	276	....	....
	DC-4	....	230	185	143	73	52	....	....
	DC-6	....	109	195	299	325	301	....	....
	DC-7	....	....	....	132	220	217	....	....
	DC-8 (Jet)	....	....	....	....	18	81	14	....
Fairchild:	F-27 (Turboprop)	....	....	....	....	....	44	....	....
Lockheed:	L-10	41	6	....	....	....	....	....	....
	Lodestar	....	11	11	10	....	....	....	....
	Other early models	6	....	....	....	....	....	....	....
	Constellation	....	79	115	117	104	75	....	....
	Super Constellation	....	....	24	79	137	129	....	....
	Electra (Turboprop)	....	....	....	....	....	117	16	....
Martin:	202	....	24	21	23	19	15	....	....
	404	....	....	96	97	85	80	....	....
Sikorsky:	All Types	28	....	....	....	....	....	....	....
Sud Aviation:	Caravelle (Jet)	....	....	....	....	....	....	19	1
Vickers:	V-700 (Series) (Turboprop)	....	....	....	54	67	61	....	....
	V-800 (Series) (Turboprop)	....	....	....	....	15	13	....	....
Other		24	10	17	25	15	24	....	....
Total Fixed Wing		347	1,072	1,323	1,705	1,871	1,883	157	82
Helicopters:									
Bell:	B47	....	6	6	7	5	5	....	....
Sikorsky:	S51	....	5	3	2	2	2	....	....
	S55	....	....	5	8	5	5	....	....
	S58	....	....	....	3	6	7	....	....
	S61 (Turbine)	....	....	....	....	....	....	7	2
	S62 (Turbine)	....	....	....	....	....	1	....	....
	V44B	....	....	....	....	5	5	....	....
	V107 (Turbine)	....	....	....	....	....	....	5	5
Total Helicopters		....	11	14	20	23	25	12	7

[1] Scheduled for delivery beginning in 1963.

PERSONNEL EMPLOYED

By the Scheduled Airline Industry [1] *(1940-1960)*

Year (Dec. 31)	Pilots and Copilots	Other Flight Personnel	Pursers, Stewards, Stewardesses	Communications Personnel	Mechanics	Aircraft and Traffic Servicing Personnel	Office Employees	All Others	Total
1940	2,279	33	1,036	193	5,413	4,277	7,689	1,131	22,051
1941	2,664	49	1,210	220	6,389	4,931	9,710	1,285	26,458
1942	3,146	241	1,131	1,610	12,882	7,384	11,083	2,236	39,713
1943	2,332	330	992	2,196	10,411	5,191	12,832	4,995	39,279
1944	3,345	277	1,516	2,501	9,963	5,748	15,234	4,023	42,607
1945	5,897	1,046	2,486	3,477	15,943	9,447	23,904	6,081	68,281
1946	7,220	1,503	4,421	5,031	23,376	12,770	31,587	10,646	96,554
1947	6,637	1,333	4,077	3,829	21,140	11,610	32,691	3,835	85,152
1948	6,926	1,515	4,142	3,661	21,828	11,662	31,145	3,729	84,608
1949	6,843	1,602	4,341	3,581	19,535	11,674	30,148	3,270	80,994
1950	7,277	1,521	4,427	3,403	19,606	12,256	31,138	3,158	82,786
1951	8,386	1,708	5,303	3,618	23,477	14,370	35,081	3,810	95,753
1952	8,770	1,852	5,859	3,653	26,162	15,588	37,894	4,294	104,072
1953	9,437	2,146	6,106	3,567	26,105	17,353	40,319	4,359	109,392
1954	9,495	2,525	6,363	3,332	25,173	17,855	40,670	4,128	109,541
1955	10,857	2,762	7,454	3,499	29,196	19,114	45,030	4,291	122,203
1956	11,386	3,384	8,097	3,605	30,962	20,657	49,336	4,076	131,503
1957	13,286	3,797	9,450	4,004	31,162	36,052	31,799	17,640	147,190
1958	12,897	3,667	9,811	3,978	29,580	37,256	32,003	17,958	147,150
1959	14,471	4,075	10,902	4,390	32,823	43,839	32,324	21,346	164,170
1960 P	13,494	3,934	10,640	4,231	34,449	44,246	32,624	22,790	166,408

[1] Data for Alaskan and All-Cargo carriers not included prior to 1959.

P Preliminary

U.S. AIRLINES' SHARE OF AIR TRAVEL

Between The United States and Foreign Countries [A] *(Thousands of Passengers)*

	1950	1955	1956	1957	1958 [B]	1959 [B]	1960 [C]
Total Passengers to and from U. S.	2,163	3,422	3,884	4,315	5,075	5,754	6,369
By Air	1,094	2,207	2,643	3,053	3,827	4,338	4,880
By Sea	1,069	1,215	1,241	1,262	1,248	1,416	1,489
Air Share of Total (Percent)	50.6	64.5	68.0	70.8	75.4	75.4	76.6
Air Passengers via U. S.-Flag Airlines	818	1,508	1,763	1,911	2,207	2,461	2,525
Air Passengers via Foreign-Flag Airlines	276	699	880	1,142	1,620	1,877	2,354
U. S.-Flag Share of Total Air Passengers (Percent)	74.7	68.3	66.7	62.6	57.7	56.7	51.8

[A] Exclusive of travel over land borders (except Mexican air travel), crewmen, military personnel, and travelers between continental United States and its possessions.

[B] Calendar year figures for 1960, 1959 and 1958; Fiscal year figures 1950-57.

[C] Partly estimated.

Source: U. S. Department of Justice, Immigration and Naturalization Service, "Report of Passenger Travel Between the United States and Foreign Countries."

CLASSES OF UNITED STATES COMMERCIAL AIR CARRIERS

There are nine generally recognized classes of operators in the air transport industry of the United States. These classifications are used by the Civil Aeronautics Board in connection with the economic regulation of the industry and under the Federal Aviation Act are based largely on the scope of operations authorized or allowed by that Act. Classes One to Seven have certificates of convenience and necessity authorizing them to conduct regularly scheduled services.

1. **The Domestic Trunk Lines** include those carriers which presently have permanent operating rights within the continental United States. There are currently twelve trunk lines, most of which operate high-density traffic routes between the principal traffic centers of the United States.

American	Continental	National	Trans World
Braniff	Delta	Northeast	United
Capital [6]	Eastern	Northwest	Western

2. **The Domestic Local Service Lines** have, with one exception, been certificated since 1945. These carriers operate routes of lesser traffic density between the smaller traffic centers and between these centers and principal centers. The thirteen local service lines in 1960 were:

Allegheny	Lake Central	Ozark	Southern
Bonanza	Mohawk	Pacific	Trans Texas
Central	North Central	Piedmont	West Coast
Frontier			

3. **The Intra-Hawaiian Carriers** operate between the several islands comprising the State of Hawaii.

Aloha Hawaiian

4. **The Alaskan Carriers** provide service among the continental United States and the State of Alaska and within Alaska.

Operating between continental U. S. and Alaska		Operating within Alaska	
Alaska	Pacific Northern	Alaska	Kodiak
Northwest [1]	Pan American [1]	Alaska Coastal	Northern Consolidated
		Bristol Bay [2] [3]	Pacific Northern
		Cordova	Reeve Aleutian
		Ellis	Western Alaska
		Howard J. Mays [2]	Wien

5. **The Helicopter Carriers** presently operate between airports, central post offices, and suburbs of New York, Chicago and Loss Angeles. Originally certificated as exclusive mail carriers they now fly passengers, airfreight and air express, in addition to U. S. mail.

Chicago Helicopter Airways Los Angeles Airways New York Airways

6. **The International and Overseas Lines** include all U. S.-Flag air carriers operating between the United States and foreign countries other than Canada, and over international waters. Some of these carriers conduct operations between foreign countries and some are extensions of domestic trunk lines into Mexico and the Caribbean and to Alaska and Hawaii.

Alaska [5]	Eastern	Pan American	Transportation Corp. of
American	Mackey [2]	Pan American-Grace	America
Braniff	National	Resort [2] [4]	Trans World
Caribbean Atlantic	Northwest	Samoan [2]	United
Delta	Pacific Northern [5]	South Pacific [2]	Western

7. **The All-Cargo Lines** operate under temporary certificates authorizing scheduled cargo flights between designated areas in the U. S., and in one case to the Caribbean and in another to Europe.

AAXICO	Flying Tiger	Seaboard & Western
Aerovias Sud Americana	Riddle	Slick

8. **Supplemental Air Carriers** are authorized unlimited domestic charter operations and up to 10 flights per month individually ticketed or waybilled between any two domestic points. As of March 1, 1961, there were 35 carriers authorized for this service.

9. **Others.** What might be termed a tenth classification includes a single carrier, Avalon Air Transport, Inc., a certificated route carrier operating between Los Angeles and Santa Catalina.

Among other classes of operators are the air taxi operators and airfreight forwarders. Air taxi operators are authorized through the exemption process and can operate aircraft up to a gross weight of 12,500 pounds. There are 2,618 authorized. Airfreight forwarders also operate under exemption authority. There are 75 forwarders operating in domestic interstate and foreign and overseas commerce.

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[1] Statistical data of these carriers are included with International and Overseas Airlines.

[2] Certificated non-mail carriers.

[3] Not operating.

[4] Certified cruise carrier.

[5] Statistical data of these carriers are included with Alaskan Airlines.

[2] [3] [4] Statistical data of these carriers are not included in the statistical tables.

[6] In 1961 CAB authorized the merger of Capital Airlines with United Air Lines.

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Twenty-Second Edition

Facts and Figures, 1961

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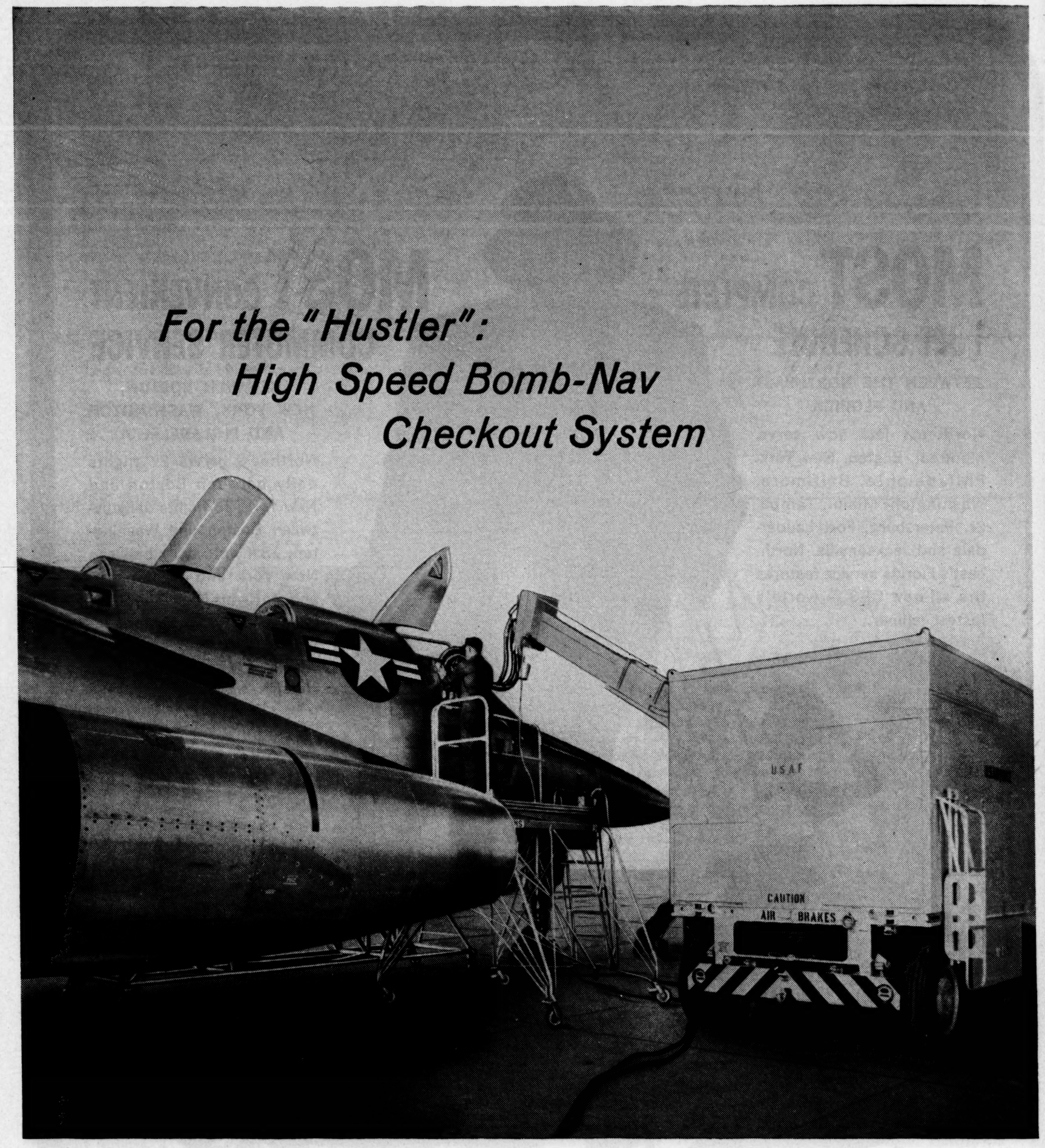
NORTHEAST AIRLINES


For the "Hustler":
High Speed Bomb-Nav
Checkout System

A new, high speed automatic checkout system developed for Convair by Sperry can make up to 3,600 different line checks on the complex bomb-nav system of the B-58 Hustler, most of which require only 4 seconds to set and complete.

In a mobile van Flight Line Tester coupled to the B-58, the AGE (Aerospace Ground Equipment) performs desired checks which are programmed by punched tape. Visual "go, no-go" readout is provided. In event of malfunction, additional rapid automatic measurements are made in repair-shop installed test sets to pinpoint the trouble.

This advanced system is now undergoing final Air Force evaluations at Carswell AFB. Significantly faster than conventional checkout methods, the highly efficient Sperry AGE system also increases the accuracy, simplicity and flexibility of testing.

The Sperry-developed bombing-navigation system has contributed importantly to the newly operational Hustler, which won the SAC trophy for both low and high altitude bombing in 1960, with only 6 weeks of operational training for its crew.

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Supersonic Designs Cover Wide Spectrum

By David A. Anderton

At least eight supersonic transport designs are beginning to take shape on engineers' drawing boards in the United States, Great Britain and France.

Scheduled for airline service in the early 1970s, these new transports will be operating in a flight regime called a quantum jump ahead of anything ever attempted in aviation.

Projected cruise speeds vary from Mach 2 to 3, with some suggestions that 3.5 is not unlikely. Cruise altitudes would start at levels of 10,000 ft. or more above the operational ceilings of today's jet transports, in the dark azure heights of 60,000 to 75,000 ft.

Ranges vary from 1,800 naut. mi. to 3,500 naut. mi. Passenger capacity is as low as 70 seats in some designs, as high as 160 in others. Configurations show the wide variety of the aerodynamicist's art. Powerplants will be operating at sustained temperatures comparable to today's afterburning military units.

Yet the state of the art will have advanced in the next decade to the point where, designers are in complete agreement, airline operations will be profitable and in some cases, extremely profitable.

National Lines

Supersonic jet transports fall into two basic categories: Mach 2 or slightly higher cruise speed, and Mach 3 or slightly higher. Adherents to the former are the British and French; the Americans hold to the latter view.

Either side can plot curves of performance parameters, weights, power required, sonic boom strength, costs and any other factor mentionable, and come up with theoretical proof that its choice of Mach number is ideal. These solutions to engineering arguments depend largely on the proper choice of initial assumptions.

The British and some Americans believe that the American choice of Mach 3 was set solely by competitive reasons shortly after North American Aviation announced its intent of building a supersonic transport based on the B-70 Mach 3 bomber. Most Americans believe that the British are stuck with the lower Mach number because their state-of-the-art knowledge doesn't permit a higher one.

One interesting phase of the effort is that spokesmen for the British seem to spend a large part of their time justifying the choice of Mach 2 or 2.2, and lambasting the U. S. preoccupation with Mach 3.

Everything from technical arguments to quotations from Shakespeare ("Your wit's too hot, it speeds too fast, 'twill tire"—Love's Labour Lost) have been mustered into the ranks of technical presentations by the British, but the effectiveness of the arguments seems to hover at a low level.

General feeling is that competition will force the first and subsequent rounds of purchases, just as it did in the subsonic jets.

If the initial orders begin to shape up around Mach 3, then a Mach 2 transport has little chance of being bought outside its own country.

The Art Advances

These proposals are not technical madness, but engineering boldness. They represent sober consideration of the problems by the free world's top design teams, airlines, government agencies and certificating organizations. The question is no longer, "Will there be a supersonic transport?," but rather, "When will supersonic service start?"

Obviously the biggest impetus to the art has been the B-70 competition, entered by most of the U.S. companies, and won by North American Aviation. Basic aerodynamic data, developed by the then National Advisory Committee for Aeronautics, now the National Aeronautics and Space Administration, has been fed into the project teams of all the companies involved. The development of a new kind of powerplant —an engine designed to cruise with full afterburner power—lends impetus to the design. Structural methods, constructional techniques, systems development for the supersonic transport—all reflect in great measure the predecessor B-70.

North American's first configuration for a supersonic transport was frankly that of the B-70. But there have been advances in the state of the art even since that sophisticated layout was designed, and today the B-70 plan is regarded as obsolescent by many engineers, including those working on North American's supersonic transport proposal.

Some of these advances have come again from NASA, others from the companies' investigations in wind tunnels of their own or other agencies. Chief among these, and perhaps the most controversial, has been the concept of variable sweep (AW May 2, 1960, p. 60), applied to the wings of the transport. Generally and inadequately described as variable geometry, the use of variable sweep is aimed at killing two birds with one stone.

At low speeds, where wing aspect ratio is a major factor in determining flight performance, the wings are spread to their maximum span and aspect ratio of 8 to 12. For takeoff, approach and landing, plus possible use in holding patterns, this high-aspect ratio wing offers the greatest aerodynamic advantages.

But then at high supersonic speeds, the wings can be folded aft to reduce the wing aspect ratio to 2 or 3. The drag goes down measurably, and the thrust required becomes more reasonable.

Backed strongly by NASA, the idea of variable sweep has been regarded with jaundiced eyes by aircraft designers. The usual complaint is that the mechanical joints are too heavy, too bulky, and would present new maintenance problems to the airline. Their volume at the wing root would take up otherwise valuable fuel storage space. And companies have wondered if they would have to certificate the airplane for the landing condition with its wings in the cruise attitude.

NASA concedes some of these arguments, and admits that its studies have not progressed far enough to get conclusive answers to the questions of cruise performance and weight penalties.

But prototypical wing joints have been built and tested under load for NASA, in designs applicable to a long-range tactical fighter, and have proven their mechanical points.

The powerplant art has advanced so greatly during the past decade that designers now can look at a choice of at least four basic engine cycles, with several types suggested for each cycle. At this stage, most designers seem to favor the turbofan engine, either with or without duct burning (AW July 11, 1960, p. 96), but one estimate says that the final choice of the engine cycle can wait until next year. Further advances over today's Mach 3 engines may be possible in that time.

Both General Electric and Pratt & Whitney Aircraft are currently running advanced components in bench tests to prove their worth for the engines of the next decade. Among these are parts which will be directly applicable to the

Mach 3 sustained cruise requirement of the supersonic transport.

Both companies have contracts for Mach 3 engines, and have run many studies on them. Both companies have tested engines at that speed; Pratt & Whitney says it has 300 hr. running time at simulated Mach 3 inlet conditions and 2,500 hr. total test time on the J58 engine. The company also points to 36,000 hr. time on components for the engine, plus other hundreds of hours on inlets and exhaust nozzles with variable geometries.

General Electric has not been quite so specific, but obviously has been running more than this in its development program of the J93 afterburning engines for the B-70 program.

A dark horse in the powerplant picture is Nord Aviation of France, which has received a study contract from USAF for a Mach 3 powerplant using a turbofan engine mounted as the central core of a ramjet. Variable geometry of inlet is used.

Part and parcel of the powerplant installation is the air intake and exhaust system. Never before in aircraft design has it been so essential for the engine and airframe to be matched so carefully. Peak performance of the engine must be maintained over a range of conditions from static thrust at the start of the takeoff run through the transonic acceleration to supersonic cruise.

Meeting these varied requirements can only be done with variable geometry on inlets and exhausts, with spill doors to control the position of the shock-wave system in the establishment of supersonic flight, and a variety of other devices used to maintain peak recovery of the inlet system.

Structural approach will have to be different, too. The brazed steel honeycomb sandwich panels proposed for the B-70 will be adapted by almost all of the manufacturers of U. S. transports.

Titanium primary structure will come into its own. But margins will have to be watched carefully, because conservation design means working to lower stress levels because of the unknown effects of long-time heat soaking on these materials.

Subsystem designs will call for new materials in seals and O-rings, new fluids for hydraulic units operating at 500F to 1,000F. Cabin conditioning systems will be working under higher pressure differentials than ever before, will be required to filter out or catalyze the ozone in the high-altitude reaches.

There is complete agreement among designers that the job is technically feasible; the uncertainties lie in unknown or undefined problems. Some of them may be of a minor nature, but some of them may spell the difference between possible or impossible operation.

Operational factors will present a whole new bag of tricks to the airlines. Takeoffs at one end of the flight, and approach and landings at the other, will continue to be comparable to those of today's subsonic jet transports. Ground handling, passenger handling, ramp parking, taxiing and towing will be the problems of the order of magnitude they are today. Almost without exception, the manufacturers agreed that today's airports and runway lengths, their ramp and hardstand areas and strengths, would have to set the limits for design of their landing gear, and specifications of their transport's turning radii.

New approaches in flight will be in the supersonic cruise, and will affect almost every established routine. Radar and radio ranges will have to increase by an order of magnitude; VOR stations every 180 mi. will be flown over at the rate of one every six minutes, leaving little time to dial frequencies. Flight planning and scheduling will be affected by the disturbance, real or imagined, of the sonic boom. Everywhere you look, there is a new kind of operational problem.

But the biggest uncertainty today

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and therefore the biggest problem facing the designers tomorrow is the sonic boom. It is ironic that this factor, almost completely out of the control of the designers, may finally determine in large measure the operational design of the supersonic transport. Magnitude of the problem is enormous; in fact, says NASA, it is the same order of magnitude as the problem of safety in supersonic flight.

There is a small, but vocal, school of thought which says that any sonic boom—just like any radiation dosage—is too much, and that therefore there can be no supersonic transport. But the majority view shared by engineers and scientists is that the problem can be solved. Each side can muster a score of reasons and arguments in support of its views.

The only fact about the sonic boom is its existence; any further data quoted is either calculation or very limited experimental results. The theory based on work done by British mathematician Dr. Gerald Whitman about 10 years ago, generally is confirmed by available test results, except that it tends to calculate noise levels on the pessimistic side.

Experimental data points come from flight tests of supersonic airplanes, and show considerable scatter, as much as 50% above, and more below, the average line. Furthermore, the observed local noise varies with topography, weather and landscape.

There are two factors which set the strength of supersonic shock waves and therefore the intensity of the sonic boom: the bow wave, or nose shock, generally a function of the fineness ratio of the design; and the wing shock system, a function of the angle of attack.

Nose shock produces the "volume boom," the major component of sonic booms from small aircraft. Wing shock produces the "lift boom," which gets stronger as the airplane altitude increases, because the wing angle of attack increases to maintain lift. As altitude increases, the lift boom becomes the controlling portion of boom intensity. This is why test data from small airplanes at lower altitude does not apply directly to the supersonic transport.

The magnitude of the noise of sonic booms is defined in terms of overpressure at the ground—the amount of increase in the normal atmospheric pressure caused when the shock wave system from a disturbance passes the observer.

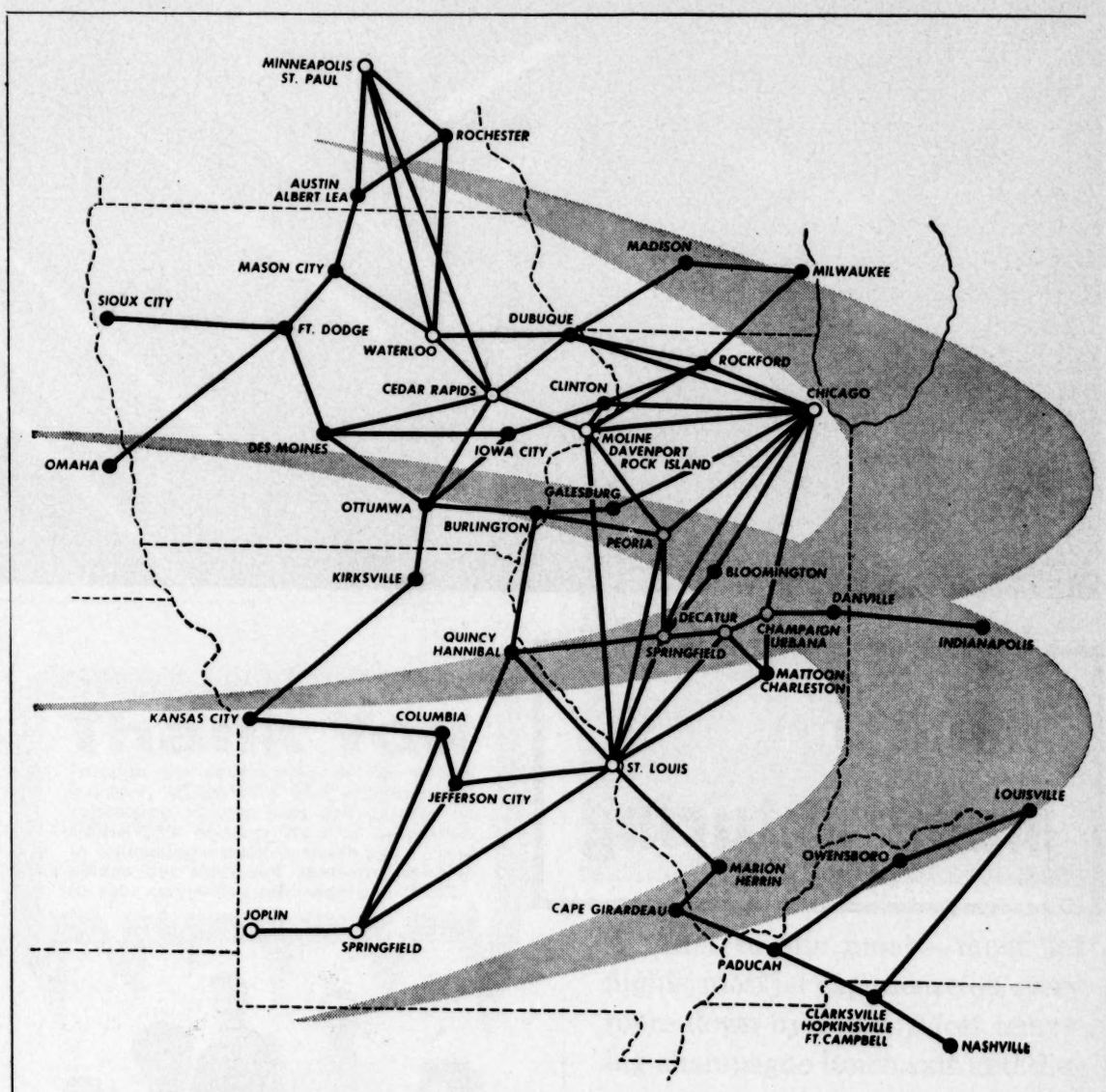
The typical and familiar sound used for comparison is distant thunder, which produces an overpressure of about 1 psf. Double this value is enough pressure rise to cause minor damage, to break large, poorly supported windows, and to provoke storms of public reaction. Threshold of physical pain is 4 psf.

Most designers of supersonic transports agree the cruising sonic boom of their aircraft will correspond to about 1.5 psf. overpressure on the ground, and feel that figure is the maximum tolerable value. This would be produced by a typical Mach 2 transport at 60,000 ft., or a Mach 3 plane at 75,000 ft.

Calculations show that maximum strength of the observed sonic boom on the ground occurs somewhere around Mach 1.5; above that speed, airplane velocity has little effect at constant altitude. Such Mach numbers are reached during climb below 40,000 ft. in most of the flight paths proposed for supersonic transports; corresponding overpressures on the ground might be as high as 3 psf., an intolerable level.

To add to the difficulties, the sonic boom extends over a swath on the ground below the flight path. Typical "noise carpet" width could be as high as 100 mi. Literally millions of people live on the future "noise carpet" of the long-haul domestic U. S. routes.

Successful educational programs have been cited as past examples of solving the sonic boom problem, generally in areas where military operations were taking place, and public response was excellent. But no amount of education



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Ultra-sonic checkout: sound waves are bounced through honeycomb panels under water to inspect brazing.

Mach 3 Manufacturing

Sounding out the inner secrets of brazed honeycomb panels

Manned aircraft are built with brazed panels of stainless-steel honeycomb in order to fly for hours at supersonic speeds. But inspection of these panels becomes a major problem because the interior of brazed honeycomb panels cannot be seen.

To solve this problem in designing the Air Force's new B-70 Valkyrie airplane, a special Quality Control Development Program was undertaken at the Los Angeles Division of North American Aviation.

The result: ultra-sonic inspection, a process that works like the Navy's sonar systems for locating submarines. By immersing each finished panel into a tank of water and then traversing a scanning head over it, sound waves are transmitted into the panel and reflected back to the scanning head. The reflections are recorded on photo-sensitized paper for a permanent record of every minute area where honeycomb and skin are brazed together. Any area that has been improperly brazed will show up instantly.

This method of inspection is just one of the many processes and advances in Mach 3 manufacturing that have been evolved by North American development programs. Other advances cover the full spectrum of triple-sonic fabrication. As a result of these programs, North American Aviation has met the challenge of Mach 3 manufacturing.

Builders of the B-70 Valkyrie

THE LOS ANGELES DIVISION OF **NORTH AMERICAN AVIATION, INC.**

gets babies used to the idea of sudden thunderclaps, and the sonic booms of supersonic transports would always wake them up.

Annoyance is also proportional to the number of times the annoyance occurs. Summer sleepers will put up with an occasional thunderstorm that wakes them, but the frequency of sonic booms could be several per hour, night after night; only the most phlegmatic personalities and soundest sleepers would be able to tolerate such disturbances.

Noise around an airport is easily complained about; you pick up the phone and make a local call. But whom does the disturbed sleeper in Council Bluffs call at three o'clock in the morning?

Educational Programs

Educational programs also miss another large segment of the living population: wild and domestic animals. Bird lovers have forced relocation of military airfields in the United Kingdom; mink ranchers and turkey farmers have won expensive damage suits against the military and against civil airlines. Convair at Ft. Worth, Tex., claims to have bought a large number of the chicken farms west of its plant as a result of B-58 flight operations.

The major difficulty in the way of solving the sonic boom problem now is the lack of extensive flight test data from large aircraft. Supersonic fighters or the larger Convair B-58 do not generate strong enough shock waves to compare with those that supersonic transports will produce.

But as a first step, flight tests of the B-58 are being made in a joint program designated "Little Boom" and being run by FAA, NASA and USAF. Data on the sonic boom intensity of large airplanes will have to wait until sometime after the North American B-70 has entered flight tests. Perhaps two or more years from now will have to pass before enough knowledge has accumulated.

At that time, designers will better understand the real problem and will then be able to work toward a real solution.

Boom Reduction

There is some indication that favorable interference of one shock wave system on another, caused by the geometry of the airplane, might reduce the boom intensity. Some estimates show this reduction will be on the order of 25%; arguments against it say that much reduction will not pay off, considering that it might change the layout or volume of the airplane.

Reshaping the flight path of supersonic transports could relieve the sonic boom problem by delaying acceleration through sonic speed to cruise at Mach 3. If higher altitudes were used for that acceleration, it would impose a tougher requirement on engines. Extra thrust needed for acceleration decreases as altitude increases; the only way to lick this is to design excess thrust capability into the engine at the cost of increased fuel consumption.

Finally, the sonic boom problem can be avoided completely by flying subsonic over inhabited areas and accelerating and cruising supersonically only above uninhabited or ocean areas. This, according to many engineers, would defeat the entire purpose of the supersonic transport. At best, it might mean an 80% increase in direct operating cost due to the inefficiency of off-design flight. The prospective total airplane market could drop as much as 50% because of the lower demand for airplanes restricted to those operating conditions.

And the lower market would in turn mean an increased initial cost to the customer.

A Convair spokesman said his company wouldn't undertake the design of a supersonic transport unless it knew the answers to the problem of the sonic boom.

The fact remains that supersonic transports are being designed, that com-

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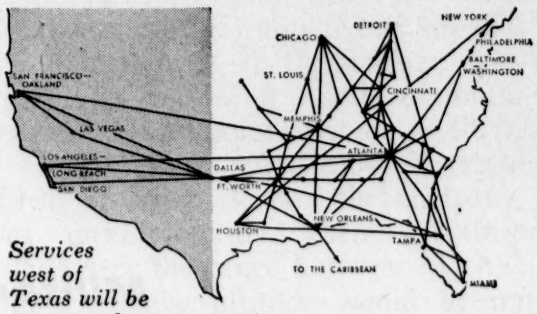

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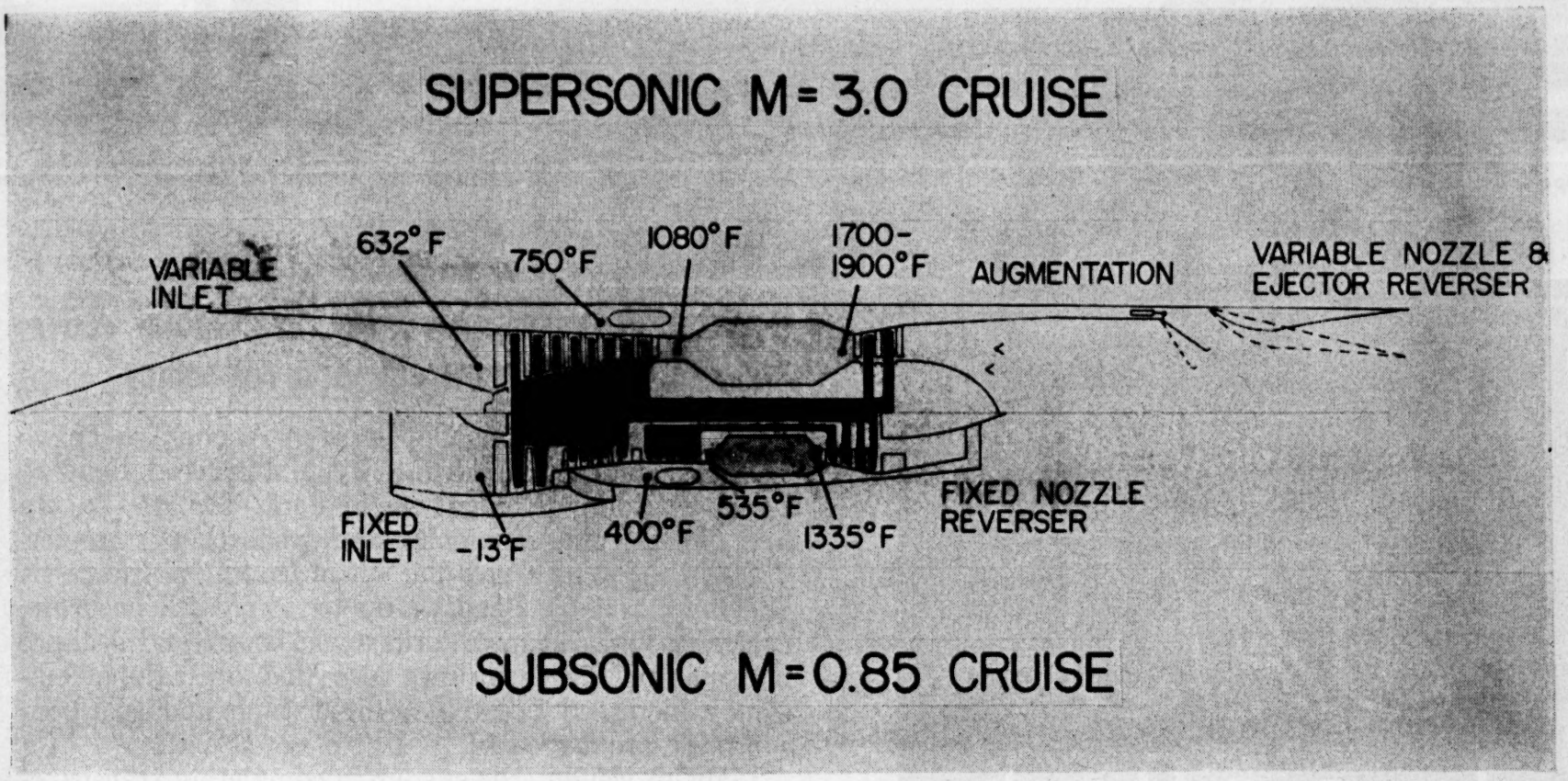


COMPARATIVE cross-sections of Mach 3 and subsonic design-point jet engines, here illustrated by Pratt & Whitney Aircraft Division, United Aircraft Corp. examples, show that basic engine proportions are not affected by the increase in flight speed. But external geometry of the inlet and exhaust systems shows major differences between the two types.

panies have project teams in existence, and that sizable sums of money are being spent right now in the United States, England and France on the development of an airplane whose future appears to be paradoxically both certain and unknown.

This is the current status of projects for which some data is available.

Boeing's Approach

Company engineers emphasize that current Boeing thinking on the supersonic transport is flexible, and that any specific configuration has not yet been defined. Groups of basic designs to meet a varied set of requirements have been developed, and they share certain figures in common.

At this stage, Boeing thinking centers around a cruise Mach number below 3, loosely stated by the company as 2.5 to 3, but probably settling out at 2.7. Corresponding cruise altitude would be 60,000 to 80,000 ft.

Typical design study for a 140-150 passenger supersonic transport shows a takeoff gross weight of about 400,000 to 450,000 lb. Aerodynamic layout is not fixed, but probably would develop into a canard delta configuration, using wingtip folding and variable geometry of engine inlets. Either podded or clustered powerplants could be used, say the engineers.

Takeoff speed would approximate 190 kt., and landing speeds would be on the order of 145 kt.

Breakeven load factor used in design is 50%, and cost studies show direct operating costs to be comparable or a few mills higher than those of current subsonic jets in operation.

Design goals for utilization and airplane life are 3,000 hr. per year for a lifetime of 10 years.

As a result of its B-47, B-52, 707 and KC-135 programs, Boeing has more big jet experience than any other group in the world. The importance of this background has not been overlooked, either by the company or by the competition. But while the total hours logged are enormous, times on individual aircraft are not that impressive.

One engineer made a quick estimate that the high-time B-47 bomber would only show a current airframe time of about 3,000 hr., and added that Pan American's high-time 707 probably had about 5,000 hr. already. That, he emphasized, was a long way from knowing anything about an airplane at 30,000 hr.

First cost of the supersonic transport is nebulous at this stage, says the company, but it would lie somewhere between $10 million and $20 million per airplane, depending on the over-all market and many other factors. One estimate of the program cost involved at the start is $50 million, which represents about twice the money—in 1961 dollars—invested in the development of the 707 prototype.

Financially, Boeing enjoys a unique advantage in the jet transport business because of the success of the 707 program. Most of the competing companies believe not only that Boeing could finance the program alone, but also worry that it might try. The company's stand on free enterprise is well-known in the industry, and Boeing officials have said that the less government influence in the supersonic program, the better it will be for everybody.

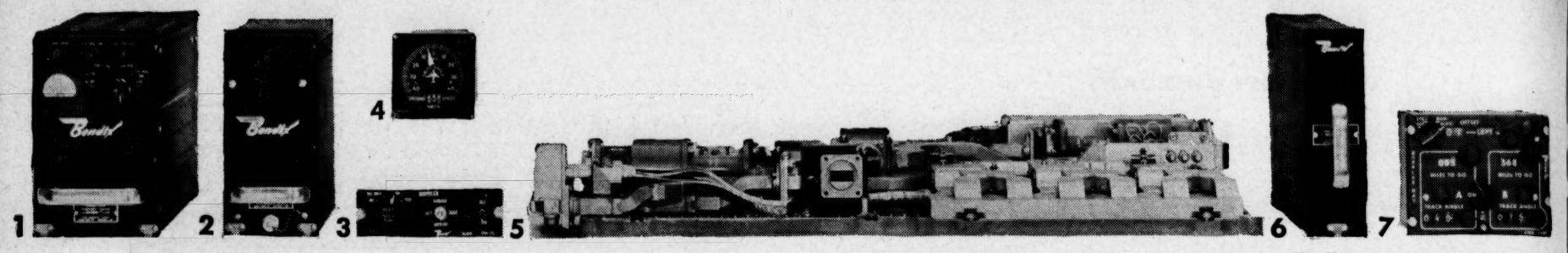
Current thinking by Convair Division of General Dynamics on the supersonic transport evolved from systematic studies begun in 1956 and continuing today. Convair's market survey report, widely regarded as an outstanding effort to define goals for the supersonic transport program, cities 324 possibilities as its basis, including 36 separate aircraft configurations. These were analyzed for three ranges, four speeds and three sizes. Three profit levels for the manufacturer were considered, as was the possibility of having one, two or three manufacturers participating in the program.

Convair proposal now widely circulated shows a delta canard layout with six turbofan engines mounted in a centerline cluster underneath the wing. Takeoff weight is estimated at 400,000 lb. Wingspan is 92 ft., fuselage overall length is 167 ft., and maximum height in three-point attitude is 40 ft.

Design cruise speed now is established at Mach 3, says the company, but until recently, their literature talked over the range between Mach 2 and 3. Cruise altitude would be up to 75,000 ft. Takeoff speed is calculated at 175 kt., and landing would be between 140 and 145 kt.

Cabin seating is provided for 130 people in a fuselage diameter comparable to today's Convair 880 subsonic jet transport.

In common with other manufac-



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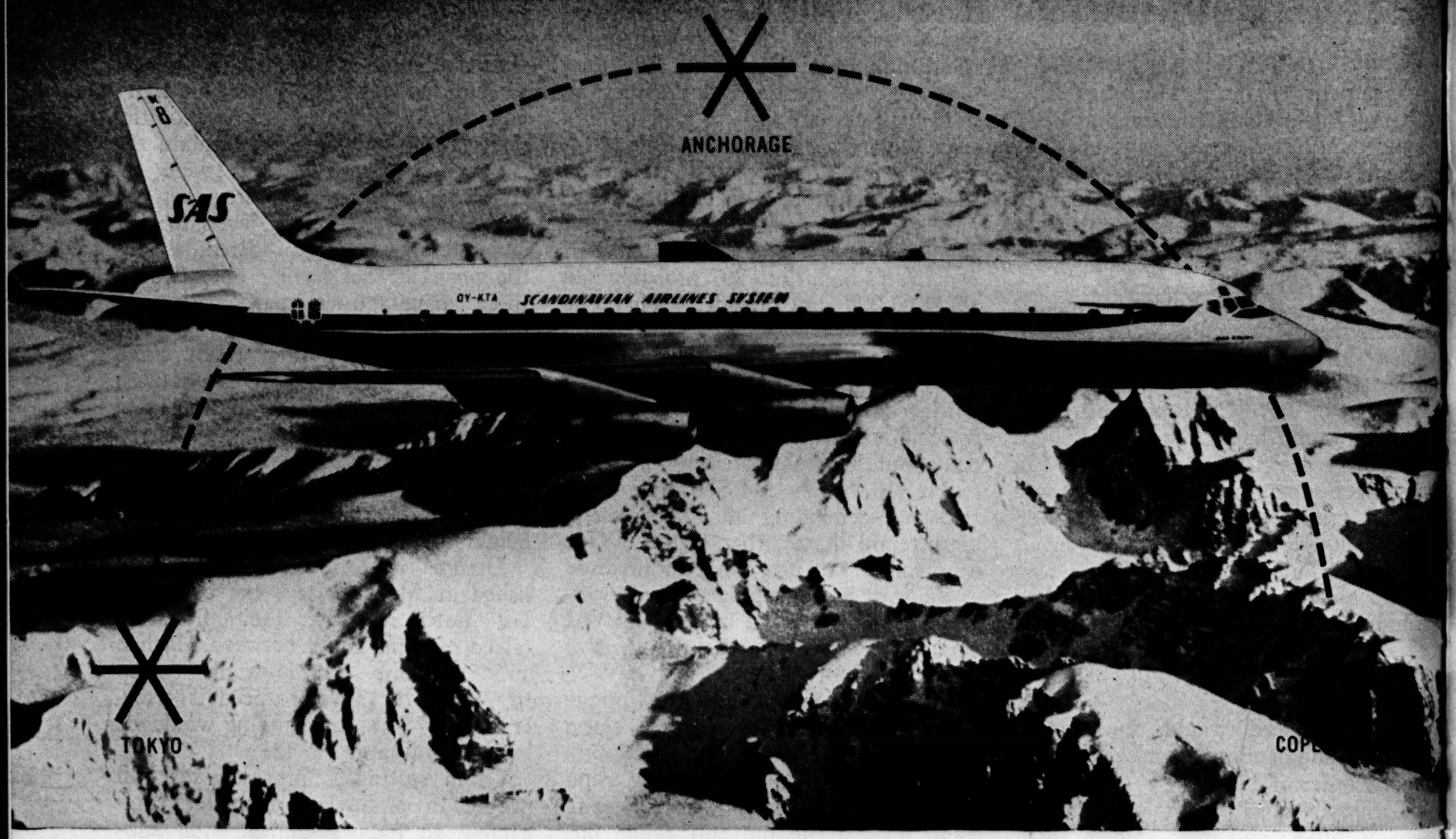

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turers, Convair is figuring on a design breakeven load factor of 50%. Using that figure, it quotes seat-mile direct operating costs a little lower than today's subsonic jet transports, presumably its own.

Design life of the airframe has been stated as 50,000 hr. so that they will be able to guarantee 30,000 hr. to the airline customers. Airframe structure would be steel and titanium, probably in the B-70 manner with brazed honeycomb sections where there are combinations of high loads and heating, and with the remainder of the structure riveted titanium skin and stringer construction.

The company says that the initial investment required to get a supersonic transport into the air would be on the order of $200 million, representing facilities and equipment as well as engineering and shop man-hours.

In spite of the company's long experience with supersonic flight, Convair is the first to point to a realistic interpretation of what that flight time really means. The B-58, first flown in November, 1956, and involved in a flight-test program of 30 aircraft, has logged about 500 hr. of time above Mach 1.5. This is out of a total of about 10,000 hr. time on the flight-test planes. Flight time at or above Mach 2 is far less.

The B-58 is the only current airplane capable of sustained supersonic flight for useful periods of time. Even so, the longest duration of Mach 2 flight with the Hustler has been a little more than one hour on a run from Seattle, Wash. to Waco, Tex.

Convair's belief is that the best approach to a program is to establish an interim supersonic transport based on the B-58C configuration powered by four Pratt & Whitney J58 engines, not now slated for any flight vehicle (AW Nov. 14, p. 54). A dozen of these airplanes, carried through development and flight test, could produce 10,000 hr. of experience above Mach 1.5 by 1967, says the company, for a cost approaching $240 million.

Even though Convair stands to benefit primarily from such a program, other companies have expressed privately their approval of such an approach. They feel that such a vehicle and the B-70, working in similar problem areas, could once and for all decide many of the technical arguments over the sonic boom, the costs and values of Mach 2 vs. Mach 3, the Pratt & Whitney J58 against the General Electric J93 engine cycles and operation, and solve a host of allied problems in accessories, equipment, hydraulic and electrical systems, navigation, traffic control and others.

Maintaining an attitude similar to Boeing's, Douglas Aircraft engineers say it is much too early to specify details of a supersonic transport geared to airline traffic of the early 1970s. Parametric studies have narrowed down the field of work, they say, but final answers are still some way off.

Result of the study program will be dependent on what the customer wants, says the company. Meantime, they have been working on a Mach 3 airplane proposal with a range of probably 3,000 naut. mi. initially, although this figure may be revised upward to meet competition.

Layout of the aircraft is a delta canard, with either four or six turbofan engines probably mounted in a centerline cluster underneath the wing.

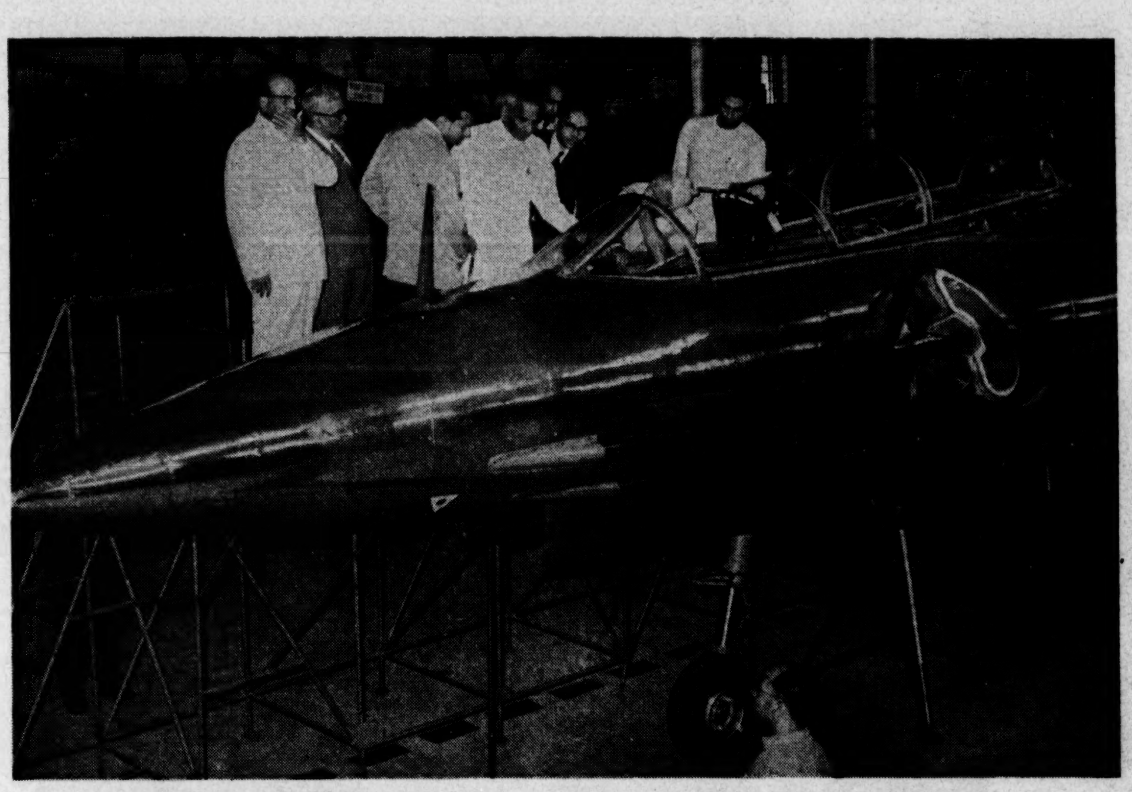
Studies cover the size range from 80 to 160 passengers, with the smaller transports weighing a minimum of 250,000 lb. at takeoff and running up to as high as 600,000 lb. gross weight in the large size. Wingspans vary between 70 and 120 ft. in the Douglas studies. Over-all length is between 150 and 200 ft., and maximum three-point height is 35 to 45 ft.

No performance figures for takeoff, approach and landing regimes are now available, but Douglas says its future airplanes will operate out of today's airports with current runway lengths.

Direct operating costs will be low enough to make possible profits well above current levels, the company indicates. First cost to the customer would be between $10 million and $25 million per airplane.

Airframe will be built of steel honeycomb sandwich and titanium skin and stringer construction.

Program development costs could be between $500 million and $1 billion, according to Douglas estimates. The company says the DC-8 program represented a $300-million investment as a comparison. They expect that 10-15 million engineering man-hours will be required to handle the study, design and development of the supersonic transport.



India's Hindustan 24 to Fly This Year

India's first supersonic fighter—the Hindustan 24—already has completed preliminary ground trials and is scheduled to fly later this year. The aircraft, designed and built at Hindustan Aircraft Factory, Bangalore, India, is expected to fly at Mach 2. India's Defense Minister Krishna Menon (fourth from left) is seen inspecting the aircraft.

Lockheed Aircraft

Serious studies by Lockheed date back about 2½ years and have been financed at the rate of about $1 million per year. A large share of this money has been spent in detailed wind-tunnel configuration studies of basic design features such as wing geometry, flight-station geometry and the placement and design of powerplant nacelles.

The company has ruled out any Mach number below 3, preferring to study the Mach 3 transport now and plan for possible stretch to Mach 3.5 in the future. Range is the standard 3,500 naut. mi. figure.

Layout of the Lockheed supersonic transport is not yet firm, a quality it shares with other manufacturers' entries. But it will probably show the familiar delta canard aerodynamic plan, with variable geometry on engine inlets and possible on wingtips. It also may have a unique application of variable geometry to the fuselage nose which rotates about an off-center pivot to provide greatly improved visibility for the flight crew in the takeoff, approach and landing regimes.

Engines will be four duct-burning turbofan powerplants, clustered in a single nacelle underneath rear fuselage.

Balanced field lengths for the Lockheed design would be those limited by

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the 10,500-ft. runways proposed as maximum lengths by the FAA. The company proposes to guarantee hot-day operations from such runways.

Specific sizes and weights are not yet defined by Lockheed, but it does say takeoff wing loadings will be on the order of 70 psf., and landing loadings will be between 40 and 45 psf.

While printed statements by the company show direct operating costs competitive to those of current subsonic jet transports, one spokesman said privately that calculations for Mach 3 show that an airline can make really large profits with the Lockheed proposal, large enough to rule out any consideration of lower speeds.

Calculations of direct operating costs were made with slightly higher breakeven load factors than those used by other manufacturers. Lockheed studies assumed 52 to 53% breakeven load factors. The company estimates the program would take eight years from go-ahead to certification of the first aircraft.

One major area of disagreement with other manufacturers is in the proposed structural makeup of the supersonic transport. Lockheed believes that skin-stringer construction in steel and titanium has advantages which outweigh the use of the possibly lighter brazed honeycomb sandwich construction. Major disadvantages cited for the sandwich structure are the difficulties of inspection and maintenance and the higher development and manufacturing costs.

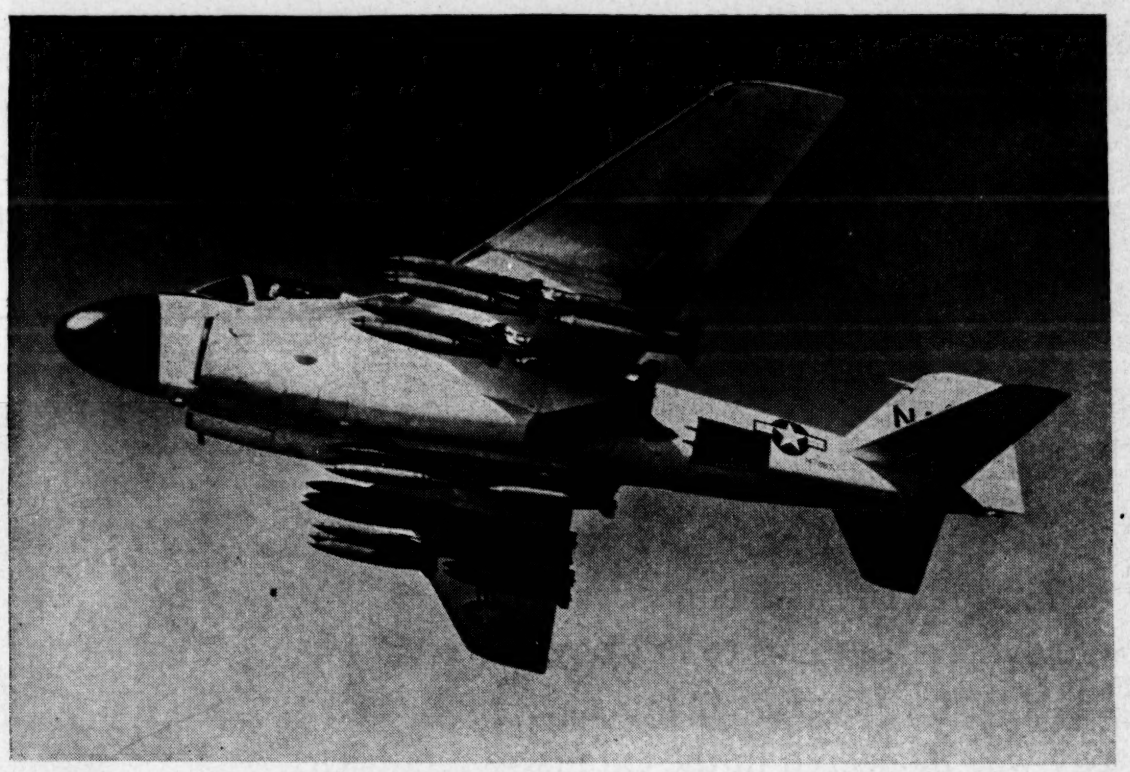
Lockheed concedes that sandwich structure strength and fatigue characteristics are possibly somewhat superior to the skin-stringer fabrication.

Sandwich construction would be used for structures where both compactness and smoothness are required with minimum gage; powerplant inlets, ducts and possibly wing leading edges would be honeycomb pieces.

North American Aviation

First go-around in the supersonic transport field was probably started by North American's B-70 contract. The aerodynamics, powerplant, structure and systems of that airplane were seen as applicable in large measure directly to the design of a supersonic transport.

The B-70 is being designed to cruise at Mach 3; the natural swing from that design is to a supersonic transport with the same cruising speed. Once North American made the decision to go for a supersonic transport, other manufacturers were faced with meeting the same cruise Mach numbers. That reason, rather than curves of aerodynamic parameters, is widely believed to be the major one behind U.S. industry's agreement on Mach 3 cruise flight.



Grumman A2F-1 Carries 15,000-lb. Bomb Load

Ground-support capability with non-nuclear stores is demonstrated by Grumman A2F-1 Navy attack aircraft carrying thirty 500-lb. bombs. The carrier aircraft mounts stores in tandem three-bomb clusters on four wing stations and one belly station.

But North American has progressed beyond the aerodynamics of the B-70 while shooting for its transport performance. Their current configuration studies still center around a canard delta geometry with folding wingtips and variable geometry on the engine inlets. But the wing is now a shoulder-wing, where that of the B-70 was a low-wing layout. And the engines, clustered under the fuselage on the B-70, are separated now on each side of the fuselage, tucked in nacelles close-held under the wing root in what Lockheed has inelegantly called the "armpit" configuration.

Powerplants right now are six turbofans with static thrust of 32,900 lb. each. These will be based presumably on the General Electric J93, but since those engines were designed as afterburning-cruise types, there may be changes made for the supersonic transport in the interests of fuel economies.

Aerodynamic design of the North American entry will also feature boundary-layer control on wing flaps and leading edges, as well as on engine duct inlets to improve their efficiency.

Company design schedule calls for the engine cycle to be selected in its final form during next year, and for configuration selection in 1965. North American talks in terms of the early 1970s as date of entry into airline service.

Basic proposal now current in North American shows a Mach 3 cruise speed at 70,000 ft. over a range of 3,500 naut. mi. Seating capacity will be 100 to 150 passengers.

Hot-day operations from 10,500-ft. runways were design requirements for the low-speed flight range. Estimates of takeoff speed vary from 180 to 190 kt., with approach speeds between 130 and 140 kt.

Takeoff gross weight of the North American proposal is 450,000 lb. Wingspan is an even 100 ft., over-all length is 205 ft. and three-point height is 32 ft.

Construction will be like that of the B-70, with brazed steel honeycomb sandwich structure in hot, load-carrying areas. Single-skinned, riveted titanium skin-and-stringer construction will be used for fuselage and other sections.

Quoting an initial cost of $18 million per airplane not including spares, North American shows direct operating costs at a level which would not be quite as profitable as today's subsonic jet transports. Unofficially it says that direct operating cost estimates are necessarily quite vague at this stage of the design, and that it's all a question of Brochuremanship right now.

British Aircraft Corp. team, combining the considerable technical talents of Bristol Aircraft, Ltd., English Electric and Vickers-Armstrongs (Aircraft), Ltd., has turned to the design of a 120-passenger supersonic transport. This smaller, lighter aircraft is planned to operate over a 3,000 naut. mi. range, at a Mach 2.2 speed.

Details of the design have not been specified, but the general configuration has been stated to be a narrow delta-wing form, with a clustered engine array and possibly the use of wingtip folding to increase directional stability at high speed and aspect ratio at low speed.

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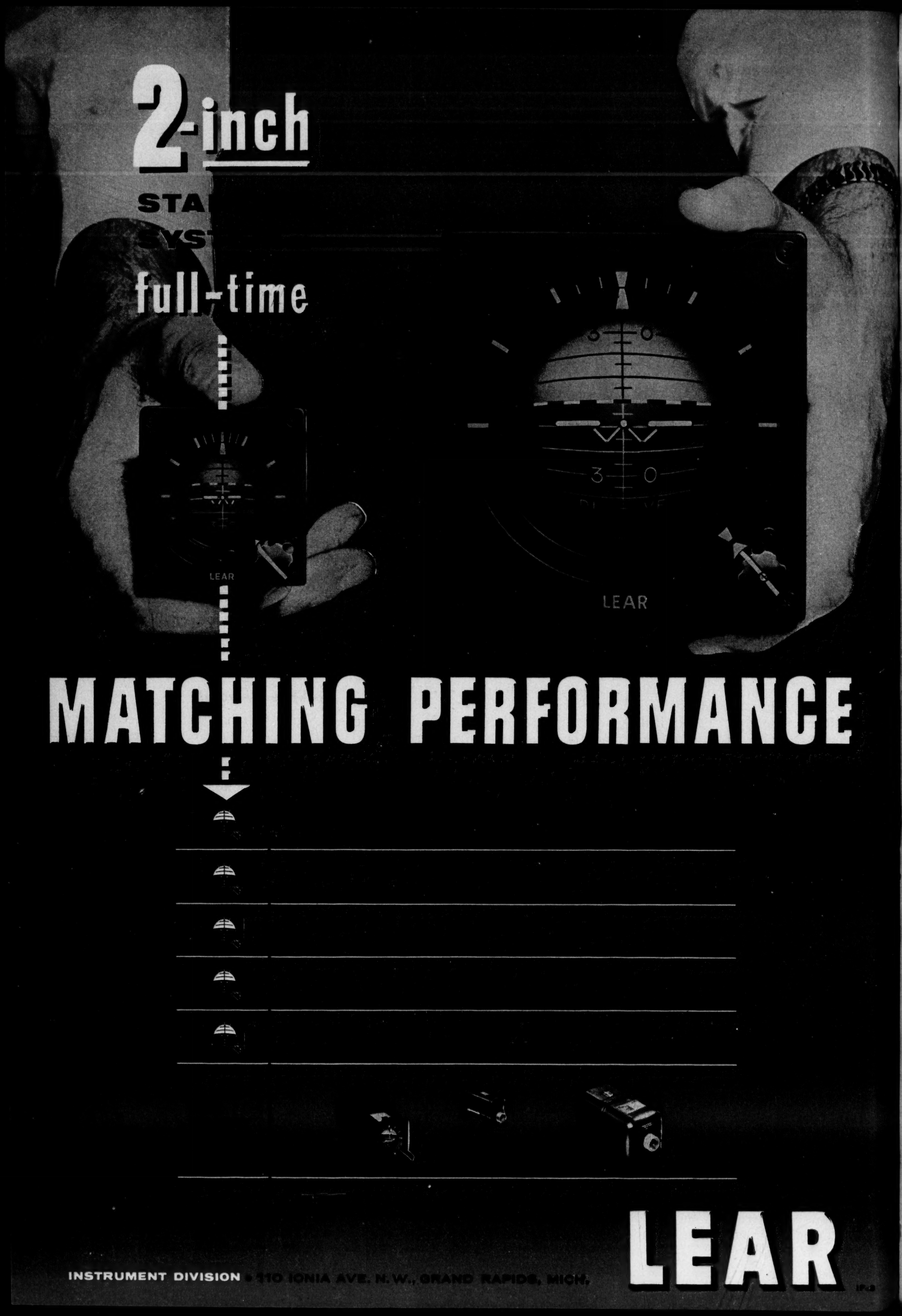
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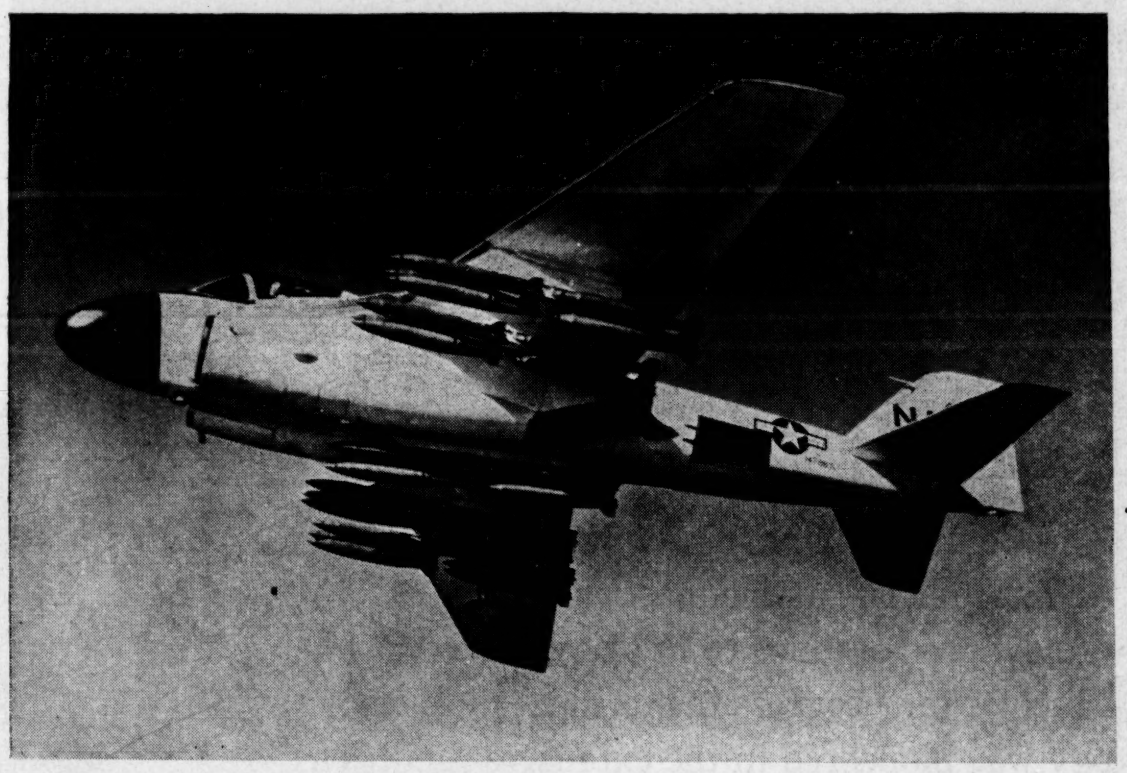

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The Columbus Division of North American Aviation is one of the most complete centers of advanced systems technology in the world. Much of the progress in our modern technology was pioneered in the extensive facilities operated by the Columbus Division. Here practical production evolves swiftly from original concepts. Economy through efficiency is the constant theme. This is true systems management capability...this is the Columbus Division.

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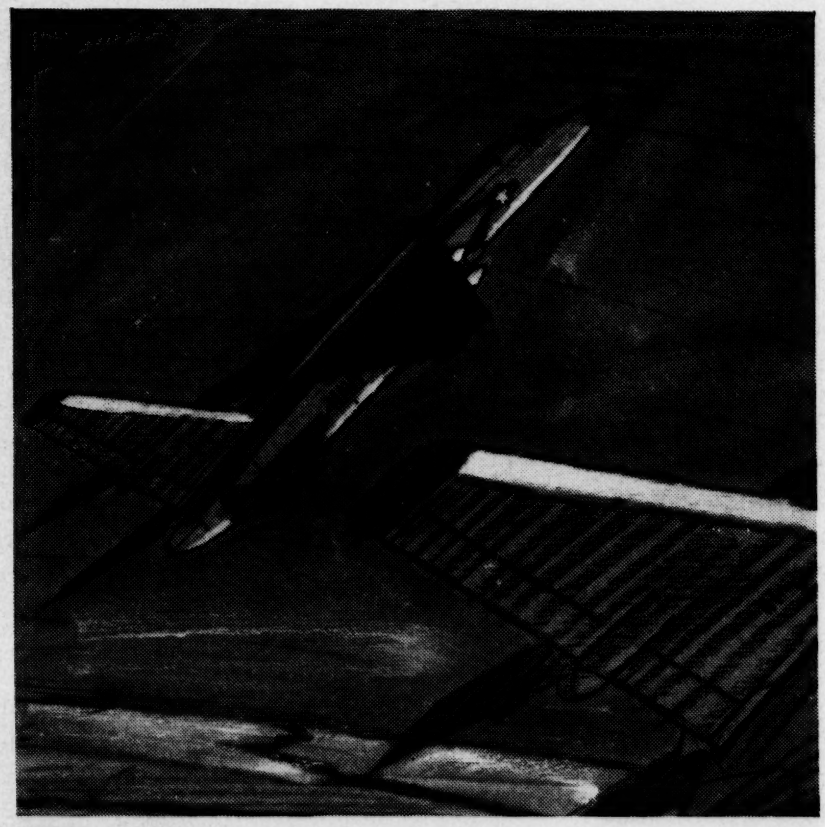
Columbus, Ohio

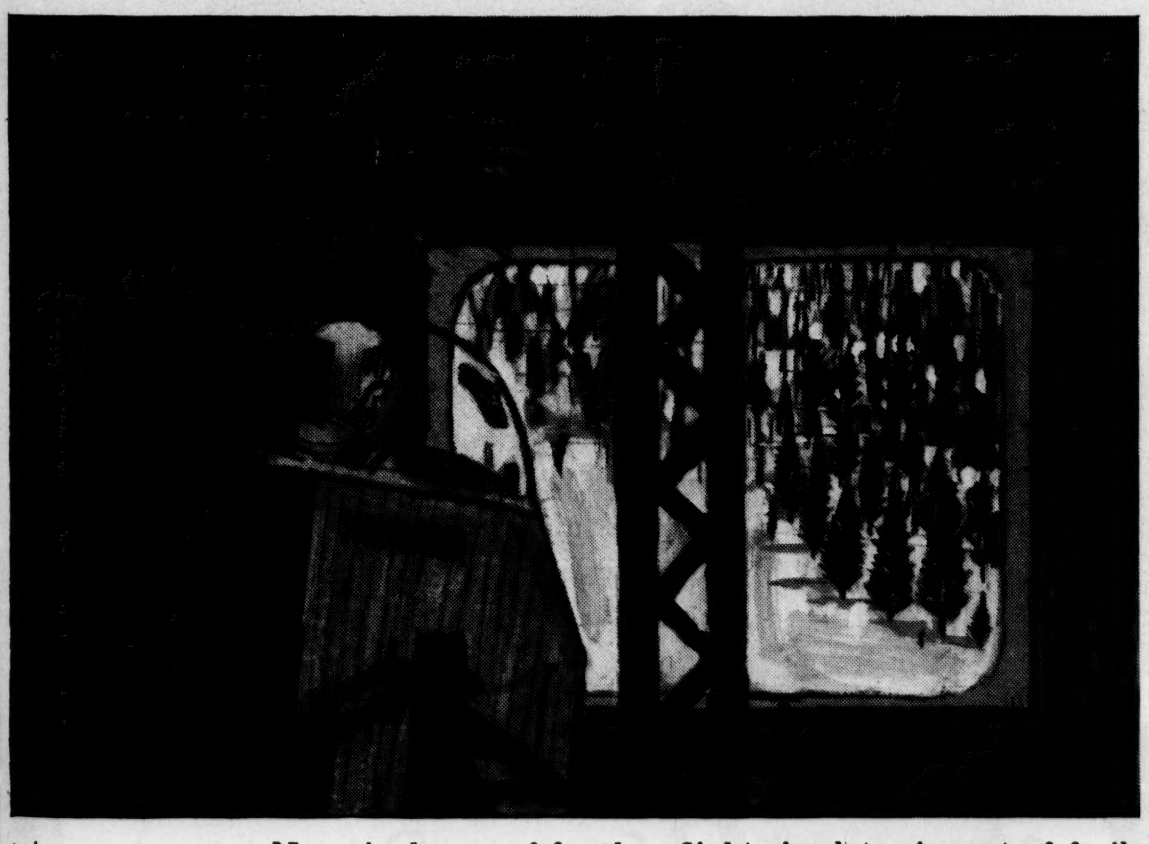


A3J VIGILANTE. Navy's A3J set a new world's record, flying to 91,450 ft. carrying a payload of 2,204 lbs. The versatile, carrier-based A3J can perform high or low level missions in any weather, from any attitude, day or night.

THE BIG "EAR." World's largest radio telescope reflector, six hundred feet in diameter, is being built by Columbus for the Navy in Sugar Grove, W. Virginia. Columbus is also building a complete antenna system for the USAF.

y at NAA-Columbus

TWO-IN-ONE TARGET MISSILE. New target missile NA-273 can carry out high- or low-level missions equally well. It performs from ground level to 60,000 feet, and from subsonic through Mach 2. Under development for the Army by the Columbus Division, it is launched by a rocket, and powered in flight by ramjet.



V/STOL FACILITIES. New six-degree-of-freedom flight simulator is part of facilities set up by Columbus Division to study requirements of vertical and short takeoff and landing aircraft design and development. Other V/STOL facilities include low-speed to transonic wind tunnel and unique lightweight ejection seat.

as 337,000 lb., with empty weight down around 152,000 lb.

Takeoff speed is estimated at 180 to 190 kt., and landing speed at 135 kt.

Construction of the airplane will be conventional aluminum alloy skin-and-stringer type.

Hawker-Siddeley Aviation, larger of the two British combines in terms of engineering strength and facilities, has released little or nothing on its work in supersonic transport. It is not possible to envision this active organization staying out of the market, so that work is more than likely well along on proposals for a Mach 2 to 2.4 aircraft of roughly the same size and weight range as the BAC entry.

Experience of the group includes much logged flight time with two large multi-jet aircraft, both civil and military: Avro's Vulcan bomber and de Havilland's Comet transport series. Supersonic flight experience is limited in the group; none of its aircraft is capable of supersonic level flight, and the logged time above Mach 1 is in the very low supersonic range and probably totals less than one hour.

The French team of Sud-Dassault, backed by government interest and some funds, is collaborating on a medium-range supersonic transport which may in effect be a Mach 2 Caravelle.

Sud Aviation, senior member, represents the major portion of the entire French aircraft industry. Its best known products are the Caravelle and the Alouette helicopter. Background experience includes some work with supersonic interceptors – Trident and Durandal.

Generale Aeronautique Marcel Dassault holds a near monopoly on French fighter design and in that position, also on most of the supersonic hours logged by French airplanes. The company is aggressive and technically respected outside of France.

The team envisions a 70- to 76-passenger transport cruising at Mach 2 to 2.2 at an altitude of about 60,000 ft. Design range is 1,800 naut. mi.

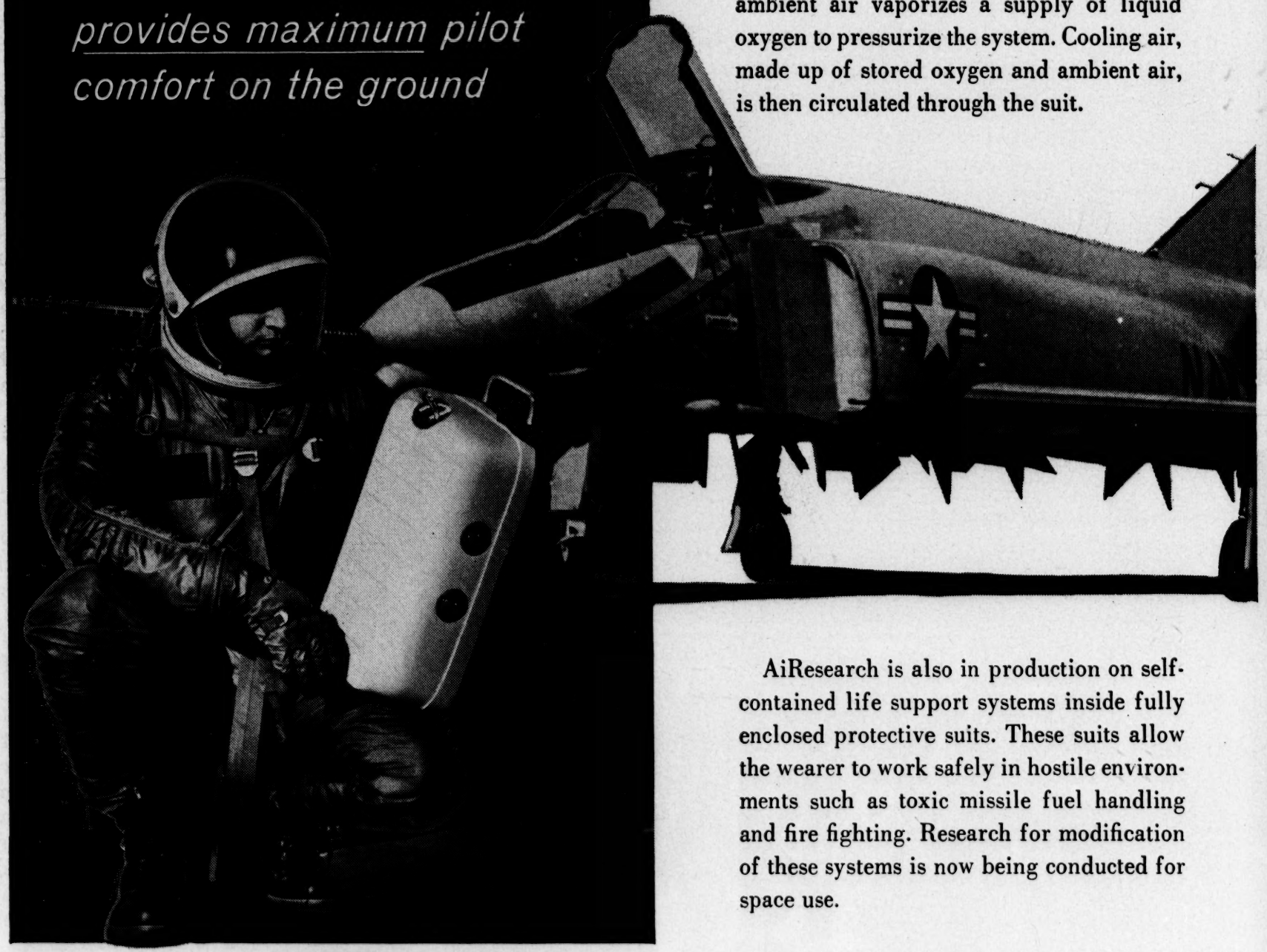
The configuration choice has narrowed to two: conventional canard with delta-wing aft, or the so-called "Gothic" or "Ogee" wing, which takes its name from the S-curved shape of its leading edge. Four turbojet engines are planned, perhaps using afterburners for acceleration phase of flight. There will be variable geometry on the engine inlets, not on the wings.

Gross weight at takeoff is estimated between 155,000 and 170,000 lb. Conventional construction is planned. Current runways and airport facilities are being set as standards for hot-day operations of the transport.

Operational costs are calculated to be comparable to those of the Caravelle.

AiResearch pressure suit cooling unit

provides maximum pilot comfort on the ground



This portable, lightweight package keeps the pilot cool and comfortable on the ground in his flight pressure suit from one to two hours. Utilizing cryogenic liquid oxygen as the coolant, it requires no electric power or other connecting supplies which might hinder the pilot's mobility.

Easily carried by hand or slung from the shoulder, the AiResearch unit can cool a pilot wearing either full or partial pressure suit during travel to and from his aircraft, preflight checkout and while seated in the cockpit. Pure oxygen for prebreathing can also be provided as a simultaneous function.

This extremely simple and reliable cooling unit has no moving parts. In operation, ambient air vaporizes a supply of liquid oxygen to pressurize the system. Cooling air, made up of stored oxygen and ambient air, is then circulated through the suit.

AiResearch is also in production on self-contained life support systems inside fully enclosed protective suits. These suits allow the wearer to work safely in hostile environments such as toxic missile fuel handling and fire fighting. Research for modification of these systems is now being conducted for space use.

• *Please direct inquiries to Los Angeles Division*

THE GARRETT CORPORATION

AiResearch Manufacturing Divisions

Los Angeles 45, California • Phoenix, Arizona

Systems and Components for: AIRCRAFT, MISSILE, SPACECRAFT, ELECTRONIC, NUCLEAR AND INDUSTRIAL APPLICATIONS

PRODUCTION BRIEFING

Waterbury Mfg. Division of the Benrus Watch Co., Inc. has been awarded contracts in excess of $1.25 million by both the Navy and the Air Force for guided missile launching equipment. Requirements include modularized or transistorized electronic equipment applicable to both infrared and radar-seeking Sidewinder missiles.

Hill Electronics, Inc., will develop a precision oscillator for the radio launch control system of the Minuteman missile. Electronics System Division of Sylvania Electrical Products, Inc. awarded the $285,000 contract.

Ionosphere Research Laboratory at Penn State University has been awarded a $25,300 NASA study grant to investigate the feasibility of using a mother-daughter rocket system to measure electron densities in the upper atmosphere. If the method proves feasible, Penn State is expected to request NASA sponsorship of a series of experiments probably with the Javelin high altitude rocket.

Trace Elements Corp., a unit of Union Carbide Corp. has signed a new purchase contract with the Atomic Energy Commission to provide the government with uranium concentrates valued at $20,700,000 over a period extending from Jan. 1, 1961 through December 1966. The new agreement replaces an old contract that would have expired Mar. 31, 1962.

Hycon Mfg. Co. has been awarded a $200,000 Air Force contract for design and installation of high altitude research cameras in X-15 aircraft. Program will be conducted jointly by Hycon and North American Aviation and will include construction and installation of two large ground contrast targets in the Mojave Desert.

Infrared Industries, Inc., has received an Air Force contract for more than $1.5 million for advanced development and production engineering of infrared detectors for Midas.

General Dynamics Electronic has been awarded a $497,050 Air Force contract to provide UHF and single sideband radio equipment for missile program command and control functions.

American Optical Co., J. W. Fecker Division has been awarded an $858,-720 Army contract for delivery of 12 phototheodolites (telescopic tracking instruments) to White Sands Missile Range, New Mexico.

Ryan Aeronautical Co.'s Aerospace Division has received a $1.8-million contract from the Air Force to provide 110 Q-2C Firebee target missiles for the ninth World Wide Weapons Meet. Innovations in the missile will include an automatic fuel jettisoning system and MATTS (multiple air target trajectory system) scoring devices and telemetry signal indication for flare ignition and antenna position.

AC Spark Plug Division of General Motors has received a $3,292,191 Air Force contract for platinum electrode aircraft spark plugs to be installed on C-124 aircraft.

Tracerlab Reactor Monitoring Center has received a $334,384 contract from the Navy to manufacture 58 air particle monitors to be installed on nuclear vessels. The monitors provide visual and audio signals when radioactivity reaches abnormal levels.

Baldwin-Lima-Hamilton Corp.'s Industrial Equipment Division has signed a contract with North American Aviation for just under $150,000 to manufacture a 14-ft. diameter ring assembly. The assembly, one of the largest hydrostatic bearings ever made, will permit almost frictionless rotation of a 120-ft. wide radio-telescope antenna.

almost invisibly . . .

trouble grows in tired metal

The enlarged piston section at the right has a fatigue crack. It is almost invisible to the naked eye, even though an etch treatment has been used to make cracks easy to see. If the inspector doesn't spot this crack at overhaul, it will grow and become as dangerous as the one in the piston at the left.

Airwork uses two separate methods of piston crack determination; (1) etching treatment, followed with a binocular microscope of the critical areas, (2) Zyglo inspection. We have some of the most extensive black light inspection facilities in the East.

You can't afford less than the best available inspection of your engine at teardown. That's one more reason why an Airwork overhaul is good insurance of reliable performance.

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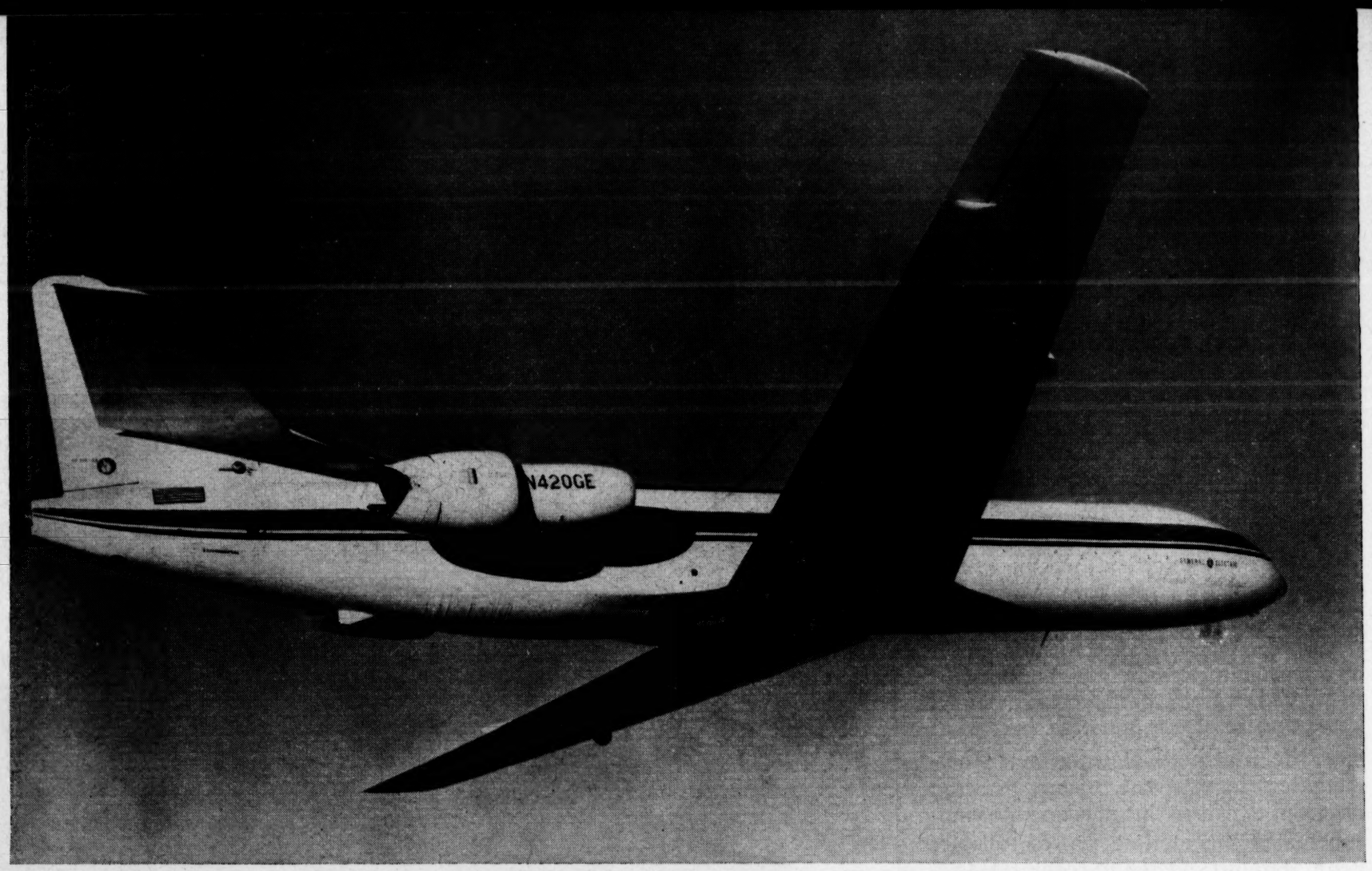


GENERAL ELECTRIC'S Caravelle III powered by CJ805-23C engines is equipped with thrust reversers. Engine cowling differs from that used by Convair on the 990 in that intake for fan is shortened.

Aviation Week Pilot Report:

General Electric Aft-Fans Spur Caravelle

By William S. Reed

Edwards AFB, Calif.—Stepped-up performance for the Sud Aviation Caravelle through the installation of General Electric aft-fan engines has given the twin jet transport the small field capability GE hopes will make it a leading contender in airline orders for the short-to-medium-haul market.

Purchased from the Sud factory in Toulouse, France, last summer, the Caravelle "Santa Maria" has been flown more than 200 hr. by GE test pilots. More than 100 hr. of this time were put on the aircraft before the CJ805-23C aft-fan engines were fitted to gather comparative data. Since the first flight last December, GE crews have flown the remainder of the airframe time in an intensive test program which will provide data for certification of the production Caravelle VII by Sud.

A recent flight in the Caravelle here by AVIATION WEEK showed the aircraft to have ample power reserves and very pleasant handling qualities in both normal and engine-out flying conditions and to possess adequate small field landing and takeoff performance.

The Caravelle GE has modified with CJ805-23C engines is a Mark III model and a one-of-a-kind item. Subsequent GE-powered Caravelles will be designated Mark VII and will differ considerably from the aircraft GE is operating. The VII, now being constructed, will have a 3.2 ft. extension in the fuselage ahead of the wing and will accommodate an extra row of seats.

The longer fuselage will permit an increase in gross weight and also will compensate for the extra weight of the heavier aft-fan engines in the rear. GE reports that Sud expects to fly the Caravelle VII in mid-1962. Sud reportedly will be able to deliver Caravelle VIIs in the last quarter of 1962, thereby offering delivery a full year before Boeing expects to deliver its first 727 (AW Mar 6, p. 60).

Impractical Retrofitting

As to whether existing Caravelles could be modified to accept the larger engines, a GE engineer said he considered retrofitting with CJ805-23 aft-fans to be too expensive to make the operation practical. In addition to installing the engines and pods, GE had to relocate engine mounting frames because of different attach points between their engines and the original Rolls-Royce Avons and a farther aft engine center of gravity due to the aft-fans; location of the rear lavatory had to be changed; revisions to the bleed air ducts had to be made because the CJ805 uses 17th stage air which is considerably hotter than the air coming off the lower compression-ratio Avon, and an auxiliary power unit was added in the tail to replace the electrical starting system used by the Rolls-Royce engines.

GE operates the aircraft with the same gross weight limitation pertaining to the Avon-powered models, i.e., maximum gross takeoff weight is 101,400 lb., max. landing weight 96,570 lb. The Mark VII will have its takeoff gross increased by 13,240 lb. to 114,640 lb. and the landing weight increased to 109,172 lb.

A complete certification program would be necessary if the present aircraft were to be certificated to the higher weight and this is not necessary for the program GE intends to carry out which is to obtain engine and aircraft performance data for application to the Caravelle VII. On a continuous basis, data taken are transmitted to Sud for verification of the computations made on Caravelle VII performance.

Flight characteristics of the GE Caravelle III, N420GE, were tried by this AVIATION WEEK pilot on a day when weather at takeoff consisted of strong gusty surface winds quartering from the left, blowing sand, temperature 20C (61F), altimeter 29.84 in Hg., runway elevation 2,300 ft. Gross weight at takeoff was near maximum, 101,240 lb., and center of gravity was at 30.6% mean aerodynamic chord. Preflight computations showed that V_1 speed was 118 kt. and V_2 speed was 125 kt.

TAKEOFF improvement results from a 41% increase in thrust afforded by the CJ805-23C engines. Nacelles were built for GE by Douglas.

le Performance

GE experimental test pilots R. J. Scoles and L. V. Davis taxied the Caravelle into position on the Edwards runway and checked the output of the two 16,100 lb.-thrust engines. The aircraft is not yet equipped with a device to provide direct measurement of thrust such as an exhaust pressure ratio (EPR) gage because it is difficult to measure the output of the fan which supplies about 40% of the thrust.

The fan has a pressure ratio of 1.6, a 1.56 bypass ratio and moves a large volume of air at low pressure. Full thrust can be assured, however, by checking engine rpm., fan rpm. and fuel flow against normal values. If the inlet guide vanes of the engine are closed, (about the only abnormal condition which would limit thrust to about one half) the fuel flow also would be about one-half the normal value. This provides a positive measure of thrust in the single spool CJ805 but would not be an accurate indication of power output in a twin spool engine.

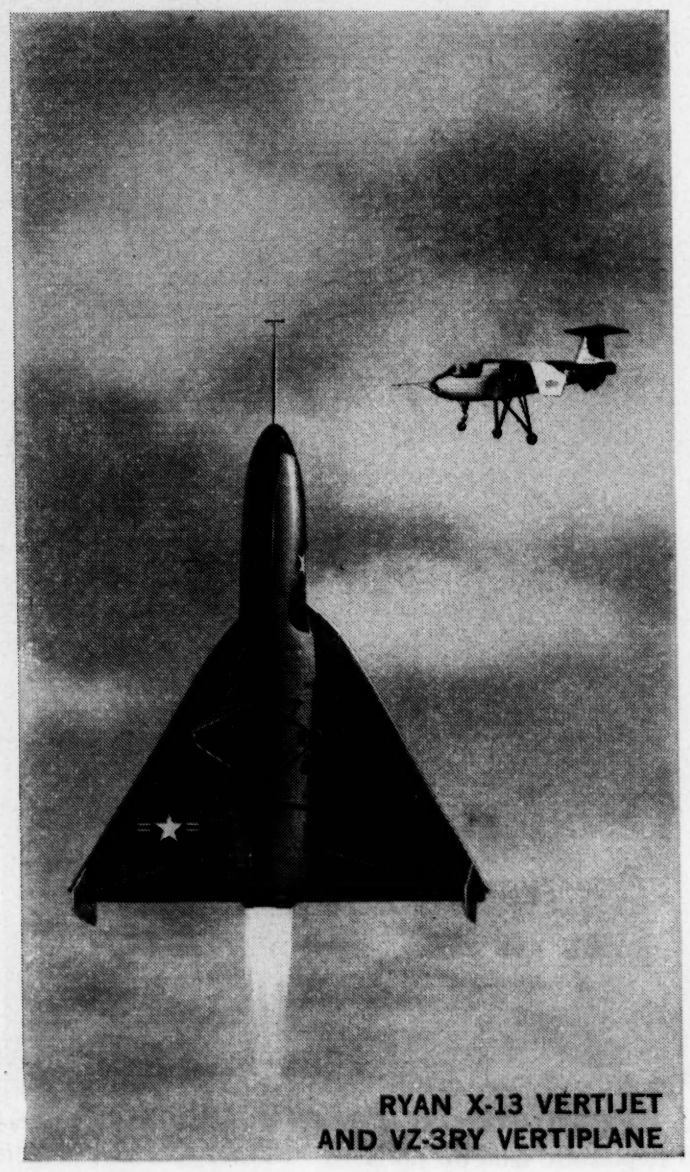
Brake Release

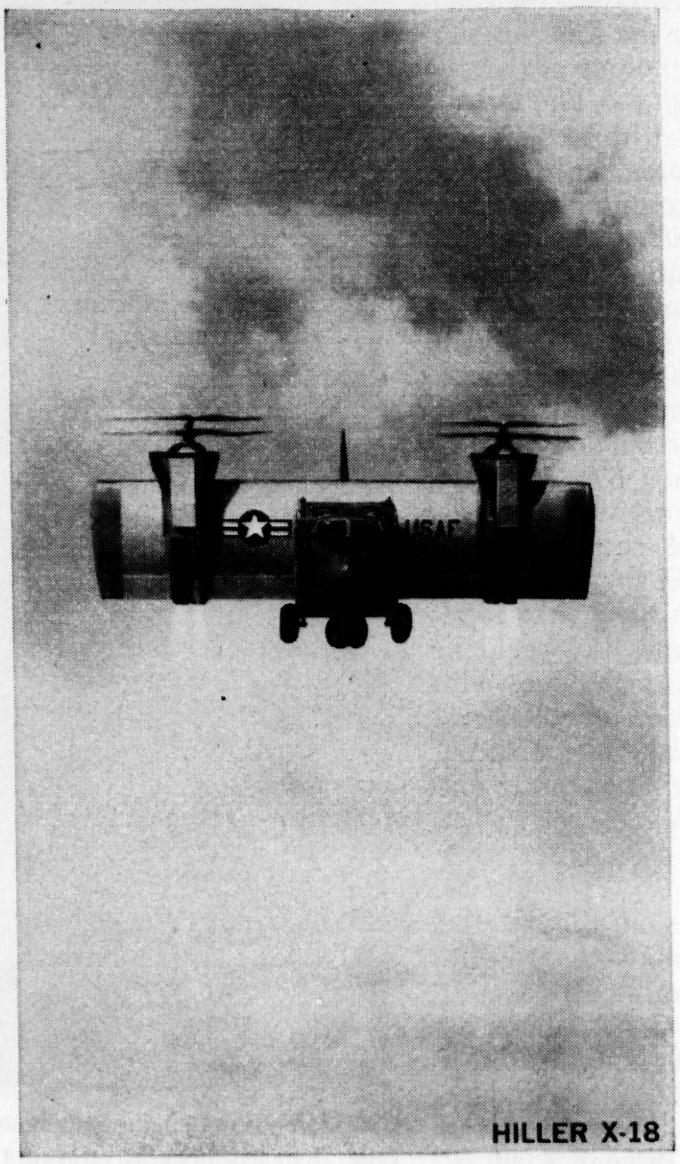
At brake release, even though the Caravelle was at maximum gross weight, the acceleration was rapid. The aircraft was airborne in about 3,700 ft. and an initial airspeed of 160 kt. produced a rate of climb of 1,800 fpm. Airspeed then was increased to 250 kt. and the rate of climb, passing through 5,000 ft.

CLOSEUP shows engine pod housing the CJ805-23C engines on the General Electric Caravelle. Fan has a bypass ratio of 1.56:1, pressure ratio of 1.6:1.

CHANCE VOUGHT "ADAM"

THREE STRONG RECORDS COMBINED FOR


RYAN X-13 VERTIJET
AND VZ-3RY VERTIPLANE



HILLER X-18

VTOL

Chance Vought, Hiller and Ryan—three key names in the advancement of vertical flight—have joined forces to design a new Tri-Service, VTOL transport aircraft for the Department of Defense.

These companies already have devoted millions of engineering man-hours to solving the design and test problems that will be vital in the development of the new transport. The complementing strengths and balance of the three-company team can be counted on to meet the challenge in the development of an operational VTOL prototype for the Army, Navy and Air Force.

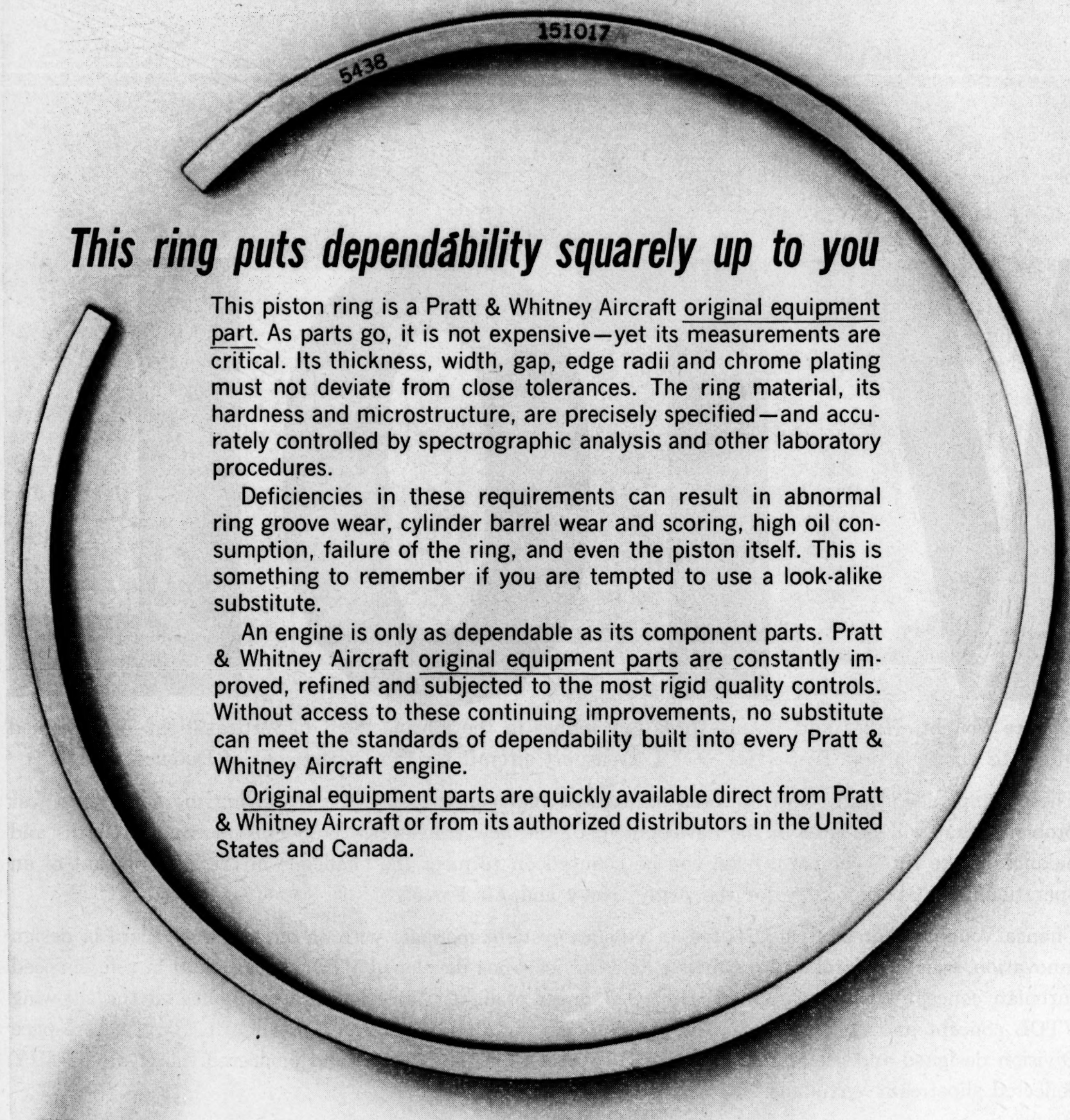
Chance Vought's Aeronautics Division—a veteran systems manager with an outstanding record in design innovation, weight control and responsive field service—has developed VTOL background in a high-speed turbofan concept known as ADAM. Hiller, producer of light utility helicopters, pioneered the tilt-wing VTOL concept and developed the Air Force X-18, world's largest V/STOL aircraft. Ryan's Aerospace Division designed and built the X-13 Vertijet—World's first jet VTOL—and pioneered the Ryan VZ-3RY deflected slipstream Vertiplane.

Here, then, is an available "first team" with advanced experience and demonstrated accomplishment in the whole spectrum of VTOL—three strong records combined under the prime management of Chance Vought to provide the capability and experience required to put the new VTOL Tri-Service transport aircraft in the air by mid-1963.

CHANCE VOUGHT

HILLER AIRCRAFT CORP.

RYAN AEROSPACE



This ring puts dependability squarely up to you

This piston ring is a Pratt & Whitney Aircraft original equipment part. As parts go, it is not expensive—yet its measurements are critical. Its thickness, width, gap, edge radii and chrome plating must not deviate from close tolerances. The ring material, its hardness and microstructure, are precisely specified—and accurately controlled by spectrographic analysis and other laboratory procedures.

Deficiencies in these requirements can result in abnormal ring groove wear, cylinder barrel wear and scoring, high oil consumption, failure of the ring, and even the piston itself. This is something to remember if you are tempted to use a look-alike substitute.

An engine is only as dependable as its component parts. Pratt & Whitney Aircraft original equipment parts are constantly improved, refined and subjected to the most rigid quality controls. Without access to these continuing improvements, no substitute can meet the standards of dependability built into every Pratt & Whitney Aircraft engine.

Original equipment parts are quickly available direct from Pratt & Whitney Aircraft or from its authorized distributors in the United States and Canada.

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East Hartford, Connecticut

CANADIAN PRATT & WHITNEY AIRCRAFT CO., LTD.
Longueuil, P.Q., Canada

Caravelle VII Specifications

Engines	CJ805-23C
Thrust	16,100 lb.
Over-all Dimensions	
Span	112 ft. 6 in.
Length	108 ft. 4 in.
Height	28 ft. 7 in.
Area	1579 sq.ft.
Sweepback	20 deg.
Performance	
Max. speed	538 mph.
Cruise altitude	35,000 ft.
Range with full pass. load	2,350 stat. mi.
Takeoff distance at max. take-off weight	6,400 ft.
Ldg. distance at normal weight	4,650 lb.
Weights—Mixed Class	78 passengers
Max. takeoff	114,640 lb.
Max. landing	109,172 lb.
Payload—space limited	18,220 lb.
Passengers & baggage	15,990 lb.

mean sea level 2 min. after takeoff, was 1,800 fpm. with engine rpm. at 99% (maximum continuous thrust) and fan speed, which is ungoverned, at 94%. Scoles then relinquished the left seat to AVIATION WEEK and the climb was continued to 30,000 ft.

First immediate impression of the Caravelle is that the aircraft has a very solid feel. Aileron and elevator response is positive and requires moderate forces. Rudder pedal forces appear somewhat high. Primary reason for the quick response and satisfactory feel of the aircraft is its all-hydraulic, irreversible control system. Control forces are artificially supplied to the pilot through a system of torsion bars on the ailerons and through an hydraulically operated artificial feel system with a "q" sensor on the rudder and elevator. Two complete and separate hydraulic systems, designated "Blue System" and "Green System," supply power to the flight controls.

Each system has two pumps, one on each engine, plus the inclusion of a "Yellow System" powered by two electric motors. Backing this up is a "Red System," also electrically operated, which contains its own reservoir and is used for operation of landing gear, flaps and wheel brakes.

Bypass features are incorporated in all actuators and on the feel system to prevent jamming of one system. Therefore, since any one of the four engine-driven and two electrically-driven pumps will run the flight controls, and the systems are parallel and independent, complete failure of the system is highly improbable. In fact, with so many redundant features and with the system

SATURN, as pictured by an artist . . . this is how SATURN may appear from Titan, one of Saturn's nine satellites. Titan is comparable in size to the earth's moon and is the only satellite with an atmosphere.

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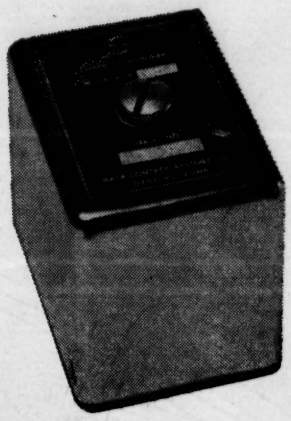

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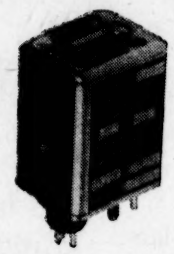

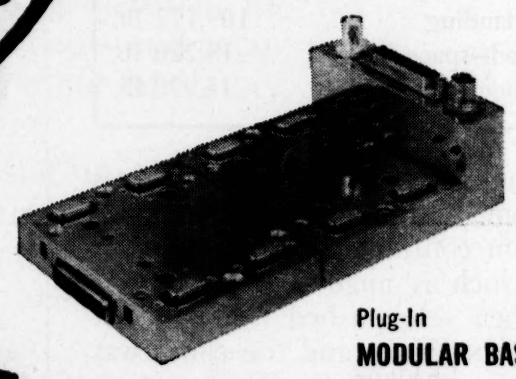

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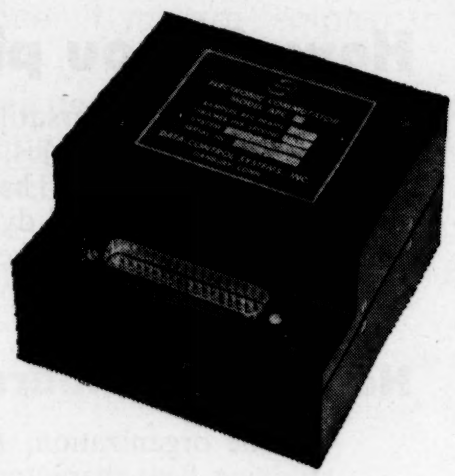

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color coding displayed on the pilot's overhead, errors in operation or failures are virtually impossible. Total result of the system is that control forces can be tailored to pilot requirements and elaborate aerodynamic tab systems with their attendant problems are eliminated.

Another impression gained on this flight is one of impaired forward visibility compared with other transport aircraft caused by having the windshield made up of eight separate panels with wide vertical members in between. Windshield is located far forward of pilot and is slanted at a 45 deg. angle reducing the vertical scanning area. This is standard with Caravelles and is an adaption almost in toto of the de Havilland Comet nose section. The forward visibility impairment became even more pronounced in nose high altitudes. United Air Lines' Caravelle VIR has a cockpit redesigned for improved visibility (AW Mar. 20, p. 35; Aug. 8, p. 53).

Altitude of 30,000 ft. was reached 17 min. after takeoff with the expenditure of 3,100 lb. of fuel from takeoff. Power was left at 99% and the warning bell, notifying that the limiting Mach was reached, sounded soon after leveling off. Speed at this time was 280 kt. IAS at an indicated Mach .77, or about 525 mph.

Without reducing power on the right engine, the left one was shutdown to check on asymmetric power conditions. Very little rudder was required and elevator trim was needed only after the speed began to bleed off due to reduced thrust. The Caravelle maintained 30,000 ft. with the one engine at maximum continuous thrust and the air-

CJ805-23C Specifications

Engine type	turbofan
Application	Caravelle VII
Takeoff rpm.	7460
Fan rpm.	5727
Takeoff exhaust gas temperature	1155F
Engine pressure ratio	13:1
Airflow of basic engine	170 lb. sec.
Bypass airflow	250 lb. sec.
Maximum diameter	
Compressor front frame	31.6 in.
Aft-fan front frame	53.0 in.
Maximum length	130.9 in.
Maximum length with reverser	166.3 in.
Weight	3835 lb.
Weight with reverser	4465 lb.
Takeoff power (SLS)	16,100 lb.
Specific fuel consumption	575
Maximum continuous power (SLS)	14,400 lb.
Specific fuel consumption	0.536
Maximum cruise power (SLS)	13,600 lb.
Specific fuel consumption	0.528
Bypass ratio	1.56:1
Bypass pressure ratio	1.6:1

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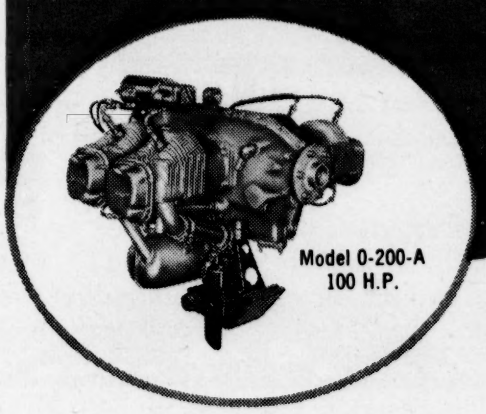
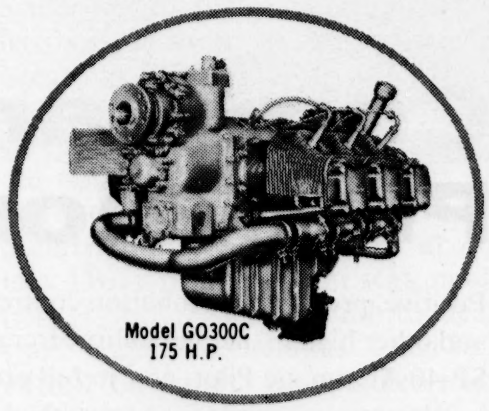
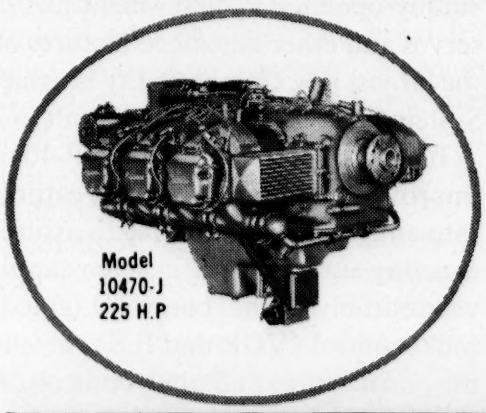

Model O-200-A
100 H.P.


Model GO300C
175 H.P.


Model
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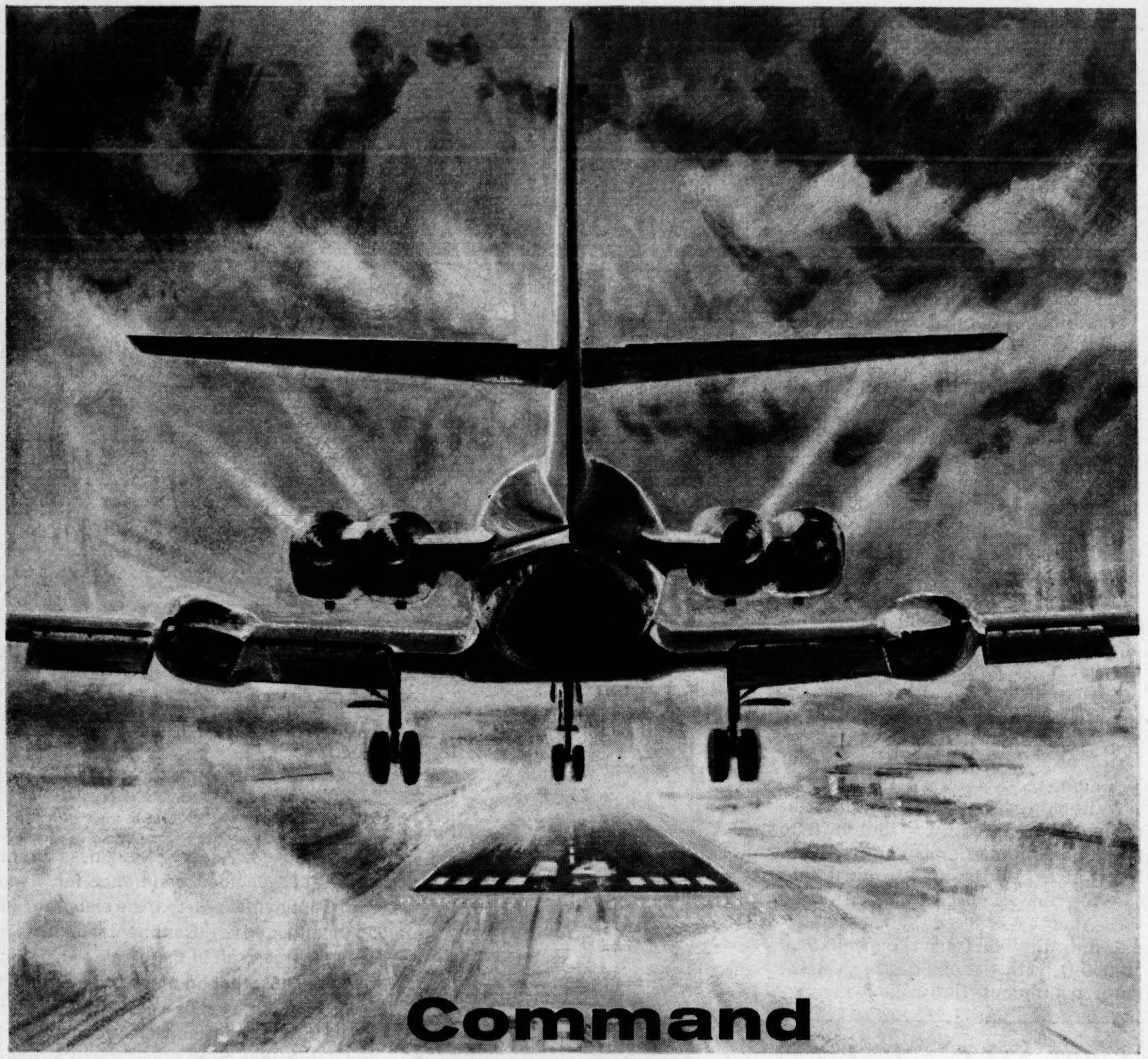

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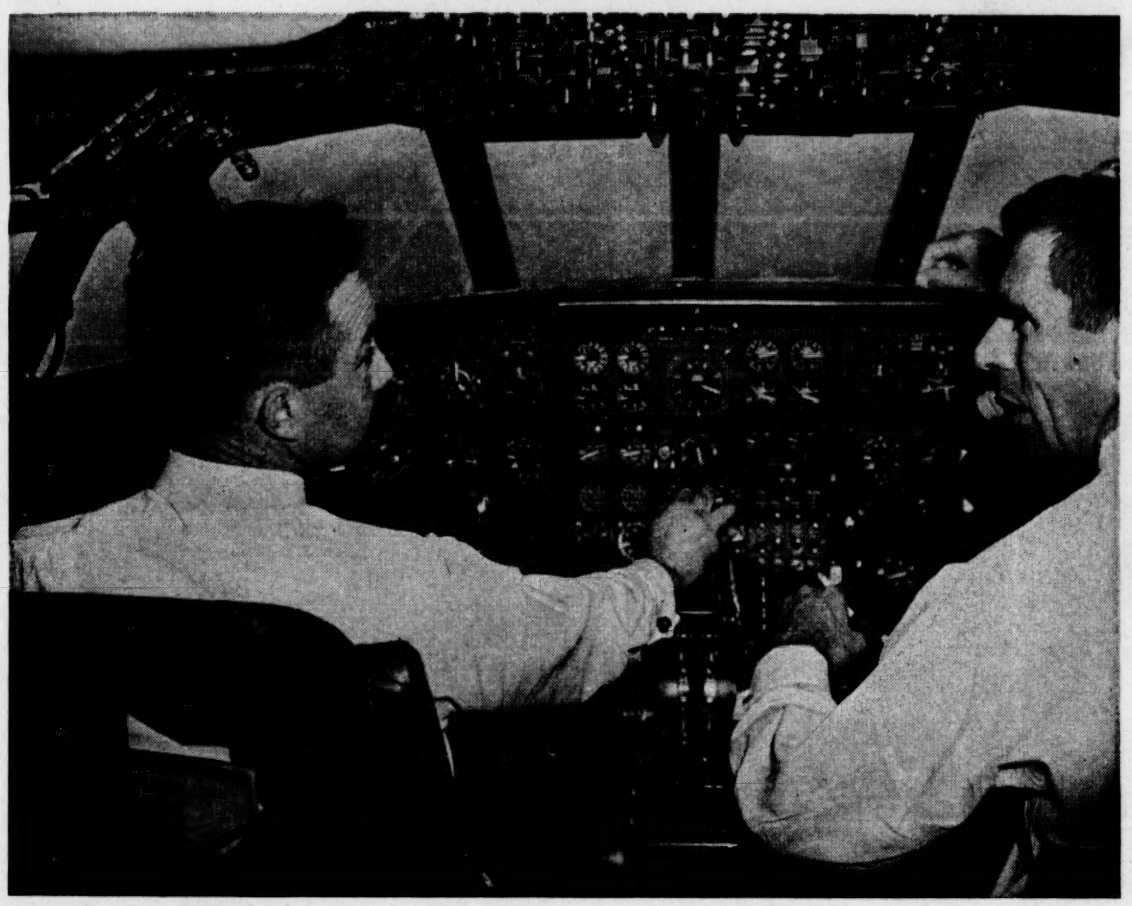


GENERAL ELECTRIC experimental test pilot L. V. "Swede" Davis (right) conducted a running commentary on aircraft performance with Aviation Week's William Reed during flight in the CJ805-powered Caravelle. Aircraft, which took off at maximum gross weight, was climbing through 24,000 ft. at 1,000 fpm. when photo was taken. Control pedestal and installation of a Lear LIFE system were only modifications GE made to the cockpit. Note size and placement of windshield panels.

speed stabilized at 230 kt. IAS. An airstart was effected while at altitude from an engine rpm. of 26.5% and a fan speed of 18%. Maximum exhaust gas temperature (EGT) reached was 500C during start.

A clean configuration stall was conducted at 30,000 ft. with engines in idle. Buffet occurred at 118 kt., the stall horn sounded at 19 deg. angle of attack together with a built-in artificial trim change which produced force on the control yoke sufficient to cause a 2-deg. nose down pitching moment. This force was overpowered manually and a stall occurred at 112 kt. at 20-deg. angle of attack.

Stall was normal in every respect with aileron control adequate and no tendency displayed to drop either wing. No pitch up tendency was evidenced at any time during or after the stall.

Buffet Margin

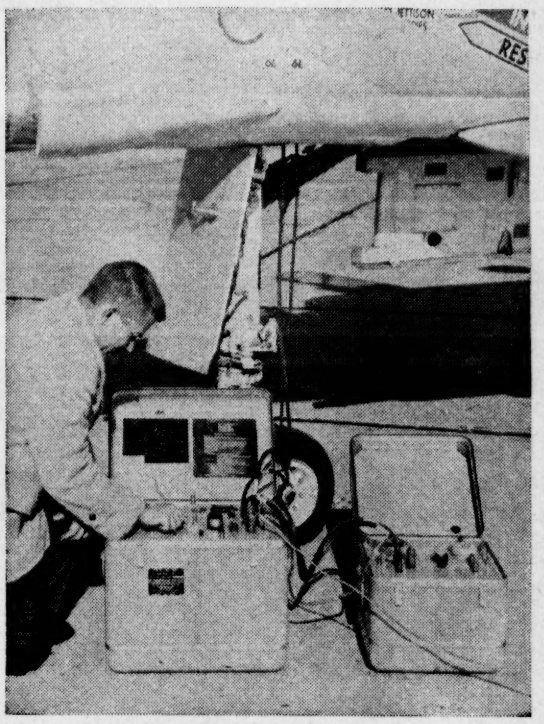
Landing configuration stall produced much the same in handling qualities with the exception that the buffet margin was not quite so great. Buffet occurred at 104 kt., simultaneous with the sounding of the warning horn and the nose down trim change. Stall occurred at about 99 kt., slightly higher than it normally does at lower altitude.

Compressor stalls, which sometimes result in flameouts, are not a problem in the GE Caravelle. Some aircraft with aft-mounted engines have been beset with stalls caused by disturbed flow into the ducts which occur at high power settings and high angles of attack. This is most critical at altitude but sometimes occurs in landing configuration. No stalls were experienced on this flight despite throttle bursts from idle to full power at 30,000 ft. in the clean and landing configuration. Scoles reports that only one engine stall has been recorded in the program, this occurring at 37,500 ft. after the aircraft already had stalled. Even this incident resulted in a typical "bang" but did not cause the engine to quit.

When the landing configuration stall occurred, the engines were at flight idle. Davis, from the right seat, rammed both throttles full forward to demonstrate engine acceleration. Even in this critical condition, the engines reached full rpm. in 7 sec. At the same time the aircraft displayed very little longitudinal trim change. The usual frantic nose down trim necessary when going from idle to full power while near a stall was not needed because the thrust line of the engines is very near to the longitudinal axis of the aircraft.

Incidentally, each engine also is offset 4 deg. inboard to overcome asymmetric thrust effects. Longitudinal thrust line, however, is offset enough so that the aircraft has positive stability with power changes. The longitudinal thrust arrangement also provides the additional advantage of not requiring an increase in horizontal stabilizer area to overcome the destabilizing effects of a 40% increase in power.

Descent was then commenced from



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- √ Mach warning switches
- √ Automatic pilot pressure sensors

For descriptive literature, delivery dates, write: Mgr. Customer Service, Electronics, Dept. 80, McDonnell Aircraft, St. Louis, Missouri

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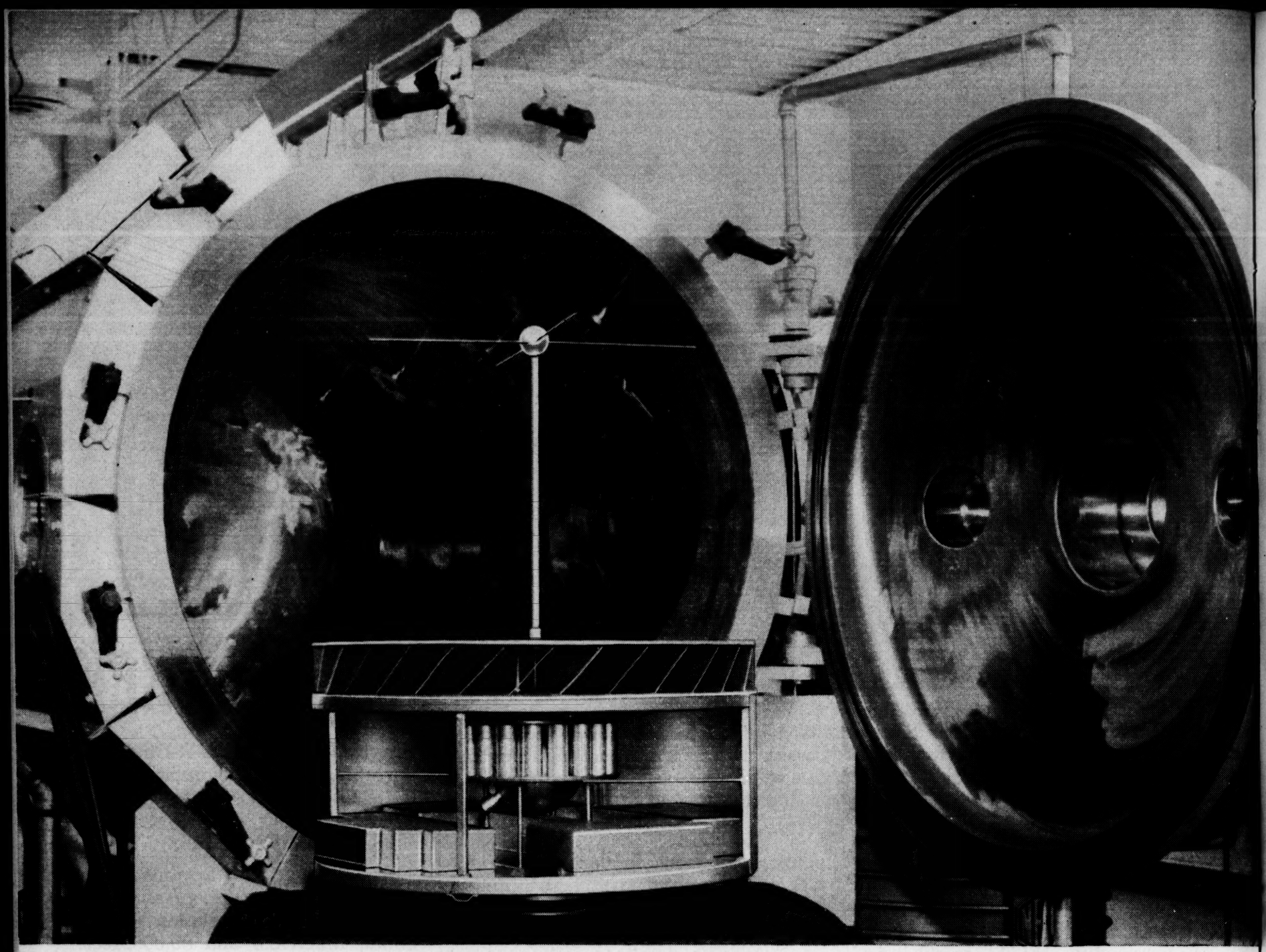

PROGRESS REPORT: BENDIX SPACE LABORATORY Another addition to our expanding Space Laboratory is this 4 x 8-foot space simulation chamber now operating at 4×10^{-9} mm Hg vacuum. We understand this is the hardest vacuum yet achieved in this size chamber. Integral wall heating and cooling allow test of small satellites and satellite subsystems at temperatures ranging from −300°F to +500°F. Accessories extend this range to −400°F to +2000°F. Our expanding facilities are creating career opportunities for senior personnel experienced in satellite and space system testing.

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30,000 ft. back to the vicinity of Edwards with the intention of conducting low altitude handling and performance demonstrations. However, on approaching 10,000 ft., severe turbulence was encountered and it was decided to discontinue this portion of the flight to avoid damage to the instrumentation and photopanel installation in the aft cabin. Plan to conduct a series of ILS approaches at Palmdale Airport and several landings at Edwards also was abandoned because of the weather which, by this time, consisted of reduced visibility due to blowing sand and a 45-deg. crosswind component at 25 kt. Scoles elected to eliminate close to the ground demonstrations so he changed seats with Davis and this pilot retired to the observer's seat, being unwilling to attempt landing an unfamiliar aircraft with the prevailing weather.

Gross weight by this time was down to 93,500 lb. and Davis entered the downwind leg with speed brakes and 20 deg. of flaps extended and airspeed at 145 kt. Approach was made at 135 kt. with the chart showing (V_{REF}) or over-the-fence speed at 123 kt. Even while approaching in turbulent air, with a strong crosswind component, Davis demonstrated that ample lateral control was available with only slight forces and movement of the wheel.

The Caravelle settled onto the runway without power at approximately 110 kt. Throttles actually were cut at about 100 ft. and a power-off flareout made—a maneuver not readily accomplished in highly swept-wing aircraft but not difficult with the Caravelle's 20-deg. sweep.

Reverse thrust was not used, primarily because of insufficient data available at the time.

Flight time, at the completion of taxiing to the GE facility, was 2 hr. 30 min. Ground handling appeared easy with the idle thrust of the engines supplying a moderate taxi speed. At low gross weights, however, some periodic braking probably will be required because of the high residual thrust of the aft fan engines.

Operating Bids Asked For Hydrofoil Craft

Washington—Maritime Administration has invited proposals for commercial operations of the 80-ton experimental oceangoing hydrofoil craft under development by Dynamic Developments, Inc.

Selection of the operator will be made on or before May 15. The 104-ft. craft will accommodate 70 to 80 passengers and have a speed of 60 knots. It will be ready for testing in mid-summer. Grumman Aircraft Engineering Corp. owns 50% of Dynamic Developments.

New Reduction Gear Box Being Developed

Reduction gear box integral with the propeller instead of the engine is being developed by Hamilton Standard Division, United Aircraft Corp., under contract to the U. S. Navy.

Substantial weight saving by elimination of duplicated housings and other components has been predicted by designers, who see a 12% saving over a conventional installation for turboprop powerplants in the 2,500-3,000 shp. class.

New gear box will demand very few basic changes in either gear train or propeller design, and will utilize proven components in most areas.

The integral gear box was part of proposals made by the division to prospective bidders in the tri-service VTOL transport competition. The company believes that a propeller-gear box combination of this type would have particular value to V/STOLs.

They point out that the concept of the integral gear box, plus the variable camber propeller (AW Aug. 15, 1960, p. 98) possibly incorporating glass fiber blades, could develop into an extremely light and efficient propulsion package for VTOL designs.

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The Callery-developed high temperature data in the next column may provide you with some new directions in your propellant systems design. Other data on pentaborane is available covering density, dielectric constant, heat capacity, solubility, surface tension, vapor pressure and viscosity vs. temperature. Write us for specific details on data and handling procedures for pentaborane.

DENSITY OF LIQUID B_5H_9 vs TEMPERATURE

Temp. (°C)	Observed Density (g/ml)
60	0.5866
70	0.5780
75	0.5741
80	0.5688
90	0.5604
95	0.5561
100	0.5522
110	0.5431
115	0.5389

SOLUBILITY OF NITROGEN IN LIQUID B_5H_9

(Total Pressure 1000 ± 7 psig)

Temp. (°C)	Solubility		
	IGPP(1)	MR(2)	H(3)
30	68.7	0.0559	8.14×10^{-4}
50	68.4	0.0607	8.87
70	67.9	0.0644	9.48
100	65.9	0.0711	10.79
129	62.8	0.0722	11.50
150	59.6	0.0779	13.07

(1) IGPP, Ideal Gas Partial Pressure (atm. Abs)
(2) MR is moles gas/ mole pentaborane
(3) H is MR/IGPP

Callery Chemical Company, Defense Products Department

Headquarters: Callery, Pennsylvania. Telephone Evans City (Pa.) 3510
West Coast: 15537 Lanark Street, Van Nuys, California. Telephone STate 1-5761

WHO'S WHERE

(*Continued from page 23*)

Changes

Pratt & Whitney Aircraft Division of United Aircraft Corp., East Hartford, Conn., has announced the following appointments: **James D. Robinson, Jr.**, chief, Western Field Engineering Department, Los Angeles, Calif., succeeding **R. L. Calleen**, now at P&W's Florida Research and Development Center; **Robert C. Baird**, assistant chief, Western Field Engineering; **Newton J. Buren**, senior field engineer, Seattle area; **Rudolph N. Wallace**, field design engineer.

J. Carl Moore, director of manufacturing, Aerospace-Rockets Division of Bell Aerosystems Co., Buffalo, N. Y.

D. F. Rich, engineering manager, Dev Tek, Inc., Orlando, Fla.

Space Technology Laboratories, Inc., Los Angeles, Calif., a subsidiary of Thompson Ramo Wooldridge, Inc., has announced the following appointments: **Dr. James G. Berry**, assistant program director for design-Titan weapon system; **Robert E. Gottfried**, head, Instrumentation Section, Communication Systems Department; **Dean N. Lowrey**, manager of administration, Electromechanical Laboratory; **William B. Fritts**, project engineer for the Orbiting Geophysical Observatory, Electronic Design Integration Department, Electromechanical Laboratory.

Dr. Charles L. Bretschneider, Washington (D. C.) office manager for National Engineering Science Co.

Dr. Cameron Knox, corporate director of research, Acoustica Associates, Inc., Los Angeles, Calif.

Harold R. Walton, manager, Product Information Department, Instrument Division of Lear, Inc., Grand Rapids, Mich.

Dr. J. Robert Downing, technical director of advanced development, Kollsman Instrument Corp., Elmhurst, N. Y., and **Louis E. Sharpe**, associate technical director for advanced development.

Harry Turner, manufacturing manager, Motorola Aviation Electronics, Inc., Culver City, Calif., and **Theodore G. Eddy**, assistant manager-manufacturing.

Robert R. Owen, manager-technical liaison, Datalab, a division of Consolidated Electrodynamics Corp., Pasadena, Calif.

Maj. Gen. Donald J. Keirn (USAF, ret.), staff assistant to the director of engineering, Wright Aeronautical Division, Curtiss-Wright Corp., Wood-Ridge, N. J.

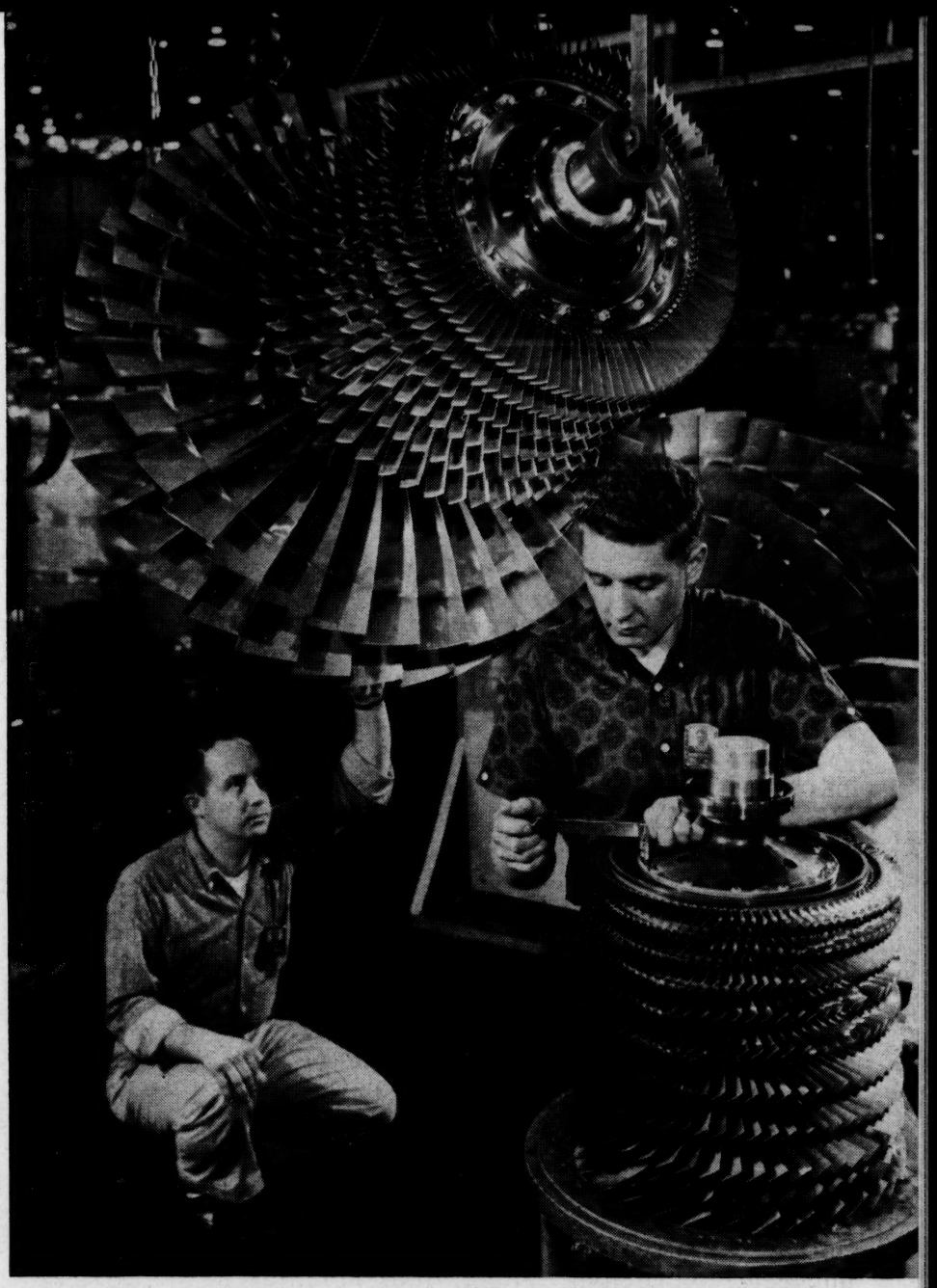
John J. Davis, project engineer for the B-10 transistorized pulse generator, Rutherford Electronics Co., Culver City, Calif.

Louis L. Reasor, manager, Hughes Aircraft Co.'s Tucson, Ariz., Division.

George Konkol, general manager, Microwave Device Operations, Sylvania Electric Products, Inc., Mountain View, Calif.

Robert H. Donaldson, manager, Contracts Administration Department, Canoga Electronics Corp., Van Nuys, Calif.

Winfield E. Fromm, director, Research and Systems Engineering Division, Airborne Instruments Laboratory, Deer Park, N. Y., a division of Cutler-Hammer, Inc., succeeding **Eugene G. Fubini**, now director of research, Department of Defense, Research and Engineering.



PRATT & WHITNEY JT3D turbofan engine (17,000 lb. thrust) is at left. Photo at right shows fan and forward compressor section of JT3D suspended in background; worker in foreground is torquing the compressor section of a JT-12 (3,000 lb. thrust) engine.

Airlines Gain Jet Overhaul Experience

More than three million hours of airline flight time accumulated by Pratt & Whitney Aircraft's four commercial turbojet powerplants have included in-service engine problems that have delayed flights or grounded individual airplanes temporarily, but no significant problems have developed to date.

Company engineers attribute this record largely to two factors: basic design philosophy of the engines, which demanded rugged and reliable components even at a weight penalty; and 2.7 million hours logged on military versions of the engines before commercial powerplants ever entered airline service.

Foreign Object Damage

Biggest surprise of the entire program was that foreign object damage failed to materialize as a major cause of premature engine removal. This trouble has plagued the military ever since they began jet operations: wrenches, gloves, flashlights, lunch bags and a host of other odd objects have been ingested and spat out again along with high-priced metal parts from the engines.

But the airlines—possibly through their insistence on the subject and continuing education of maintenance and ground personnel—have been almost trouble-free on this score. The only difficulties have been with bird ingestion, which is the point where all the educational effort has failed to pay off.

Civil Jet Powerplants

Most of the more than three million flight hours accumulated by Pratt & Whitney's current quartet of civil jet powerplants is split about evenly between the JT3C-6 (commercial version of the J57) and the JT4 (commercial J75 engines). Considerably less time has been built up on the JT3C-7, a lightened C-6 model, and only about 5,000 hr. credited to the JT3D-1 turbofan engine.

Each of these engines entered service with the airlines at 800 hr. time between overhauls (TBO). Current TBO value for the JT3C-6 is 1,800 hr., reached 30 months after the engines started commercial service. This rate buildup is exceeded by both the JT4, which has reached 1,600 hr. within 18 months after entering airline use, and the JT3C-7, now at 1,200 hr. after only eight months.

With the high daily utilization of jet transports reported by the world's airlines, it is a relatively short time cycle for a typical engine between manufacture and first overhaul. Pratt & Whitney says about five months elapse between delivery of an engine and the time it leaves first overhaul. During that interval, the airline has received, inspected and installed the engine, ground run and flight checked it, used it for normal service life and pulled it for overhaul.

The overhauling company has done work, run the engine on a test stand and sent it on its way again.

Overhaul costs vary across the industry, being dependent on wage rates and overhead among other factors. But Pratt & Whitney feels that the cost of scrapped parts gives a fair estimate of the basic charge to the airline user.

Current range for JT3C-6 engines, some of which are now in their fourth overhaul and a few in their fifth, is from $4,800 to $5,400. Costs for the bigger JT4 are higher—engines now going through their third overhaul are scrap-

ping between $7,000-9,000 worth of parts.

Cost figures do not include proprietary accessories that are part of the over-all powerplant installation, nor thrust reversers and silencers which are generally engineered and installed by the airframe manufacturer.

Most engine troubles historically have started in the hot section. The first military jet engines suffered in everything from individual burner cans to complete assemblies. But fifteen years experience with turbojets has taught industry how to solve most hot end problems by proper design at the start so that few traditional worries ever rise again for field service representatives.

The Pratt & Whitney line, like those of other engine manufacturers, still suffers some new or usual hot section problem. Even prior military operation of the engines didn't prevent some from arising.

There were some failures of third stage turbine blades on JT3C-6 engines used by Pan American that might have been expected to occur during military operations of J57 engines. PanAm had two cases where engines began running rough after takeoff. Ground inspection showed that the blades had failed in the third stage turbine and unbalanced the turbine wheel. Loads produced by the unbalance broke four support rods at the turbine assembly and allowed the rear end of the engine to whip around. External oil lines failed also in that region.

Cause of the trouble was a sharp corner at the root of the firtree connection of the turbine blades to the rim of the disk. The sharp corner produced stress concentration and the blade failed. There were two fixes made and during the fix program there were two more such failures. Ultimately, the stress raiser was eliminated by using radius on the blade root fitting; this improved the situation but engineers specified a wider rim for the turbine disk to reduce stress further.

This might have been expected to happpen during military operations of the engine but J57s used in KC-135s, primarily for pilot training, were being run at lower thrusts because of less than normal takeoff gross weights. As a result, engines did not show failures of full throttle commercial operations.

Airlines also reported some motion of the burner can assembly, which Pratt & Whitney eliminated by designing a clamp to hold the downstream end of the can assembly more rigidly.

One of the most difficult problems to track down occurred with the support assembly for No. 5 bearing. Symptoms were high oil pressures, high oil consumption and heavy oil breathing. The trail finally led to a closed, welded support structure. There were pinholes in the welds which let oil fumes into the housing. Fumes first condensed, then under high operating temperatures they vaporized and bulged the support inward by pressure so that the support rubbed the main rotor shaft. The bulge also shifted the shaft seals so that they leaked oil. The fix was a vented assembly: airflow through it prevented the accumulation of oil.

Airlines used to pull hot section inspections, but have dropped them. However, in the early stages of service, this inspection showed some erosion of first stage turbine seals. These seals, the knife-edge type just ahead of the first stage turbine, were being blasted by exhaust gases roaring out of the turbine nozzles.

Tracing the troubles back through the combustion chamber showed that the prime source of erosion was carbon buildup on fuel nozzles. Deposits would accumulate in the stagnation area on the face of the nozzle, and would eventually be blasted off as solid chunks, hurtling through the combustion chambers and impinging on the knife-edge seal.

There were two fixes: first, more cooling air lowered the metal temperatures and cooled the seal somewhat. Second, a toroidal swirl nozzle was substituted: Airflow around the nozzle face kept it free of oil accumulation.

Another reported failure in JT3C-6 engines was in the bevel gear assembly of the accessory drive shaft. The shaft drives directly off the main rotor shaft and supplies power to the engine accessories. The trouble was traced to tooth failures on the bevel gears at the frequency of tooth impact.

As in other resonant type failures, this one was fixed by changing the natural frequency of the gear rim by increasing its size. This also added some strength to the part.

Frequency failure also was the cause of some airline problems with the seventh stage of the low pressure compressor. The fix was similar: Blades were redesigned so that the natural frequency was changed and there have been no further reported troubles.

Water injection used by the airlines during early stages of the commercial operation of turbojet engines caused two problems, one minor although very annoying and the other a serious one which was detected in time.

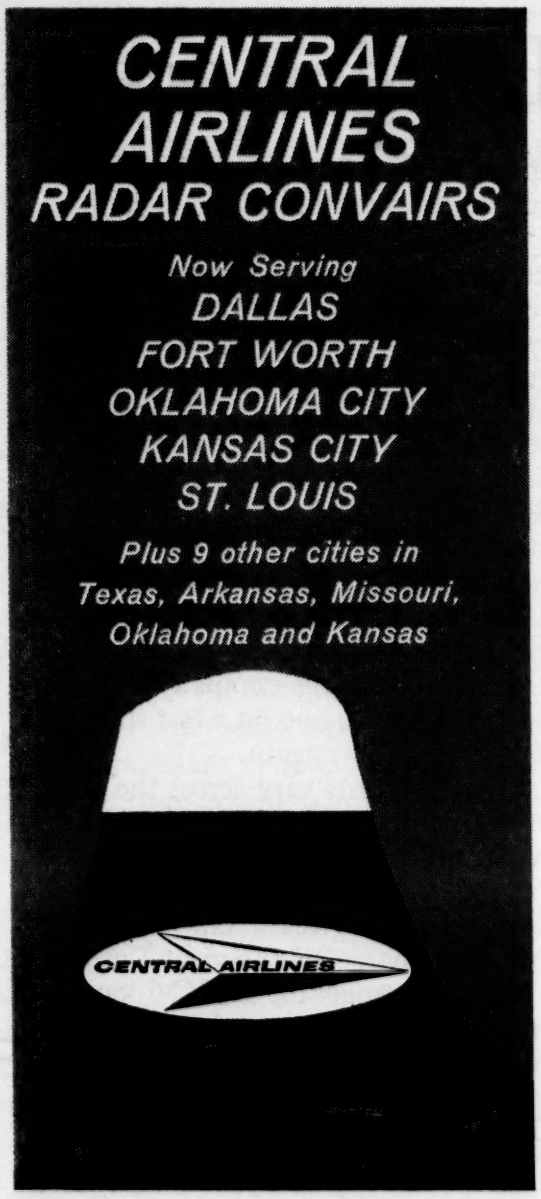
The minor one was seal failure on the water transfer pipe in the compressor section. Failures caused water leakage: water froze on the inlet housing in cold weather operations and when the engine anti-icing system went on, ice was swallowed in chunks by the engine causing flameouts. Flameouts occurred shortly after takeoff, at altitudes around a few thousand feet. A new seal design was used to solve this problem.

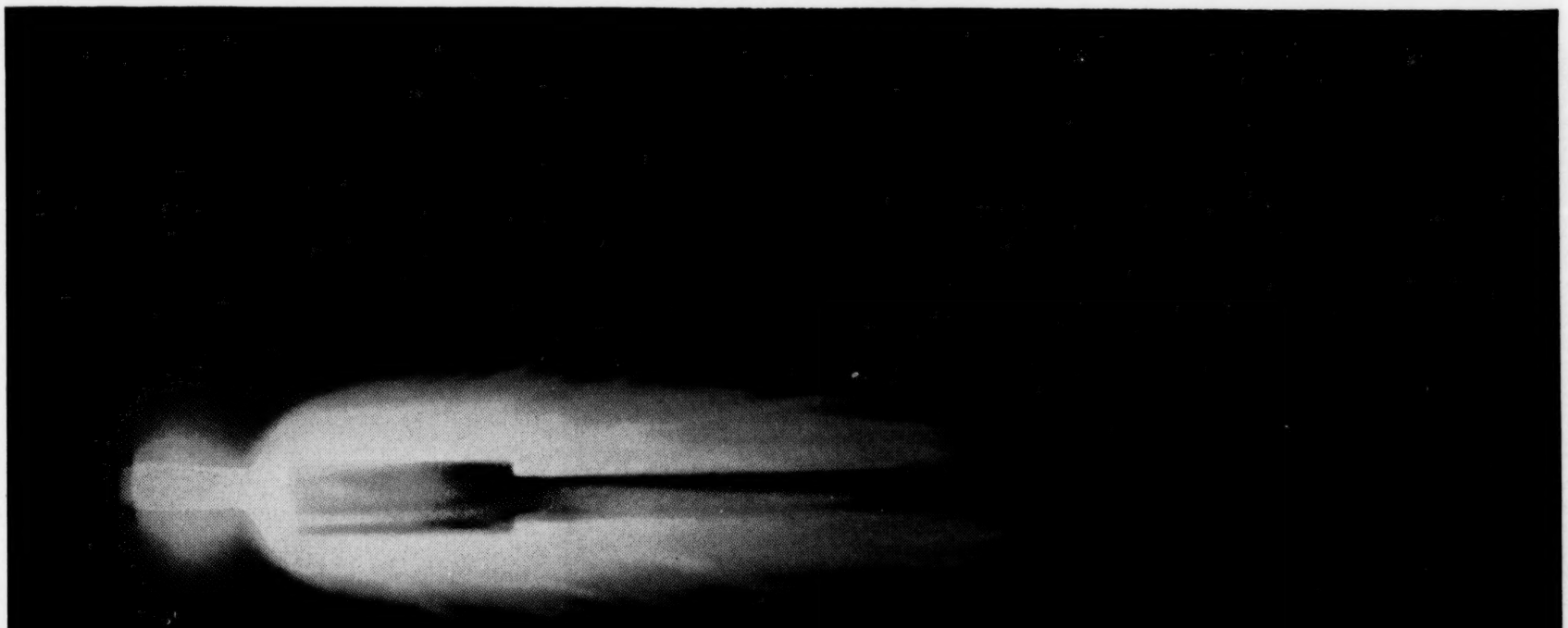
The serious failure was in the burner cover casing which developed cracks at the rear flange. In one case removed after discovery of a crack, inspection showed that the crack extended from about five o'clock on the casing clockwise all the way around to about three o'clock. If this structural casing had failed completely, all major components would have been thrown out of alignment.

Corrosion was finally pinpointed as the culprit. The water being used for thrust augmentation had not met the standards set by Pratt & Whitney for purity, and chemical action between impurities in the water and the material of the casing as areas of maximum impingement caused corrosion.

An increased radius on the inside shoulder of the rear flange was tried to increase strength, but this did not eliminate pitting of the metal. The next obvious thing was to plate the case as an anti-corrosion measure. Then the company changed the manufacturing process to make the cases by flow-turning and there have been no further difficulties with that one since.

Because of the similarity of mechanical design of the JT4 and JT3 series engines, two problems were common to both: erosion of the first stage turbine seal and failures of the third





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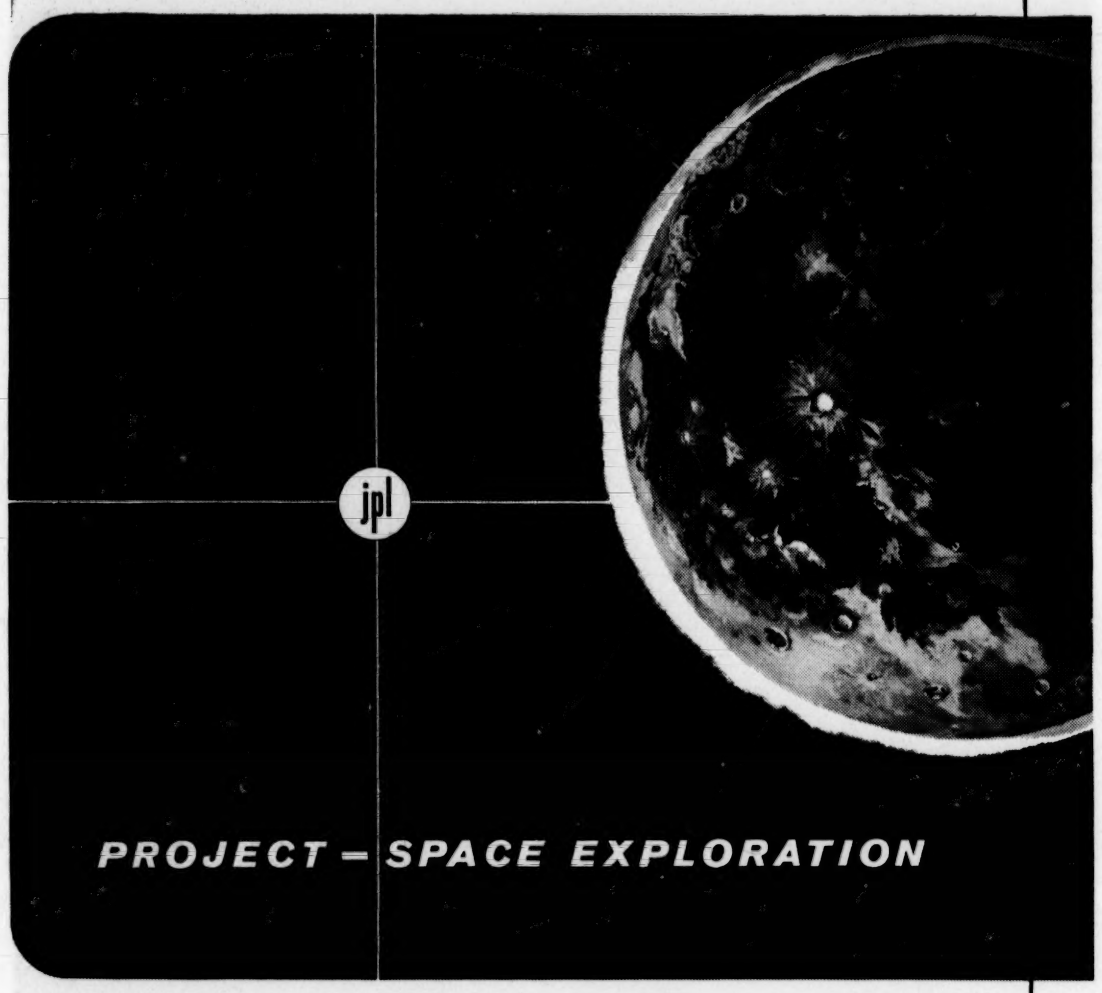

In the next decade, the United States is committed to an extensive program of space exploration. The Jet Propulsion Laboratory has been assigned, by the National Aeronautics and Space Administration, a responsibility for lunar, planetary and interplanetary un-manned exploration programs.

In the field of planetary exploration, the development and technology of automatic spacecraft and the gathering of scientific knowledge concerning the planets and their environment is involved.

By 1970, sufficient scientific data is to be acquired demonstrating the feasibility of spacecraft capable of orbiting and landing on Mars and Venus. In addition, programs will be initiated for probing Mercury and Jupiter and for further penetration into space.

The early Venus and Mars missions will utilize the Centaur launch vehicle and will constitute the "Mariner" series. These will be followed by the "Voyager" series employing the Saturn system.

The vast amount of information to be acquired, the scientific research and testing necessary, the new concepts to be investigated and the number of areas to be explored constitute an extensive long-range program. The challenge of probing the unknown, the vigor with which these problems are now being attacked and the demonstrated stability of the whole JPL operation provide career incentives for engineers and scientists in every field.

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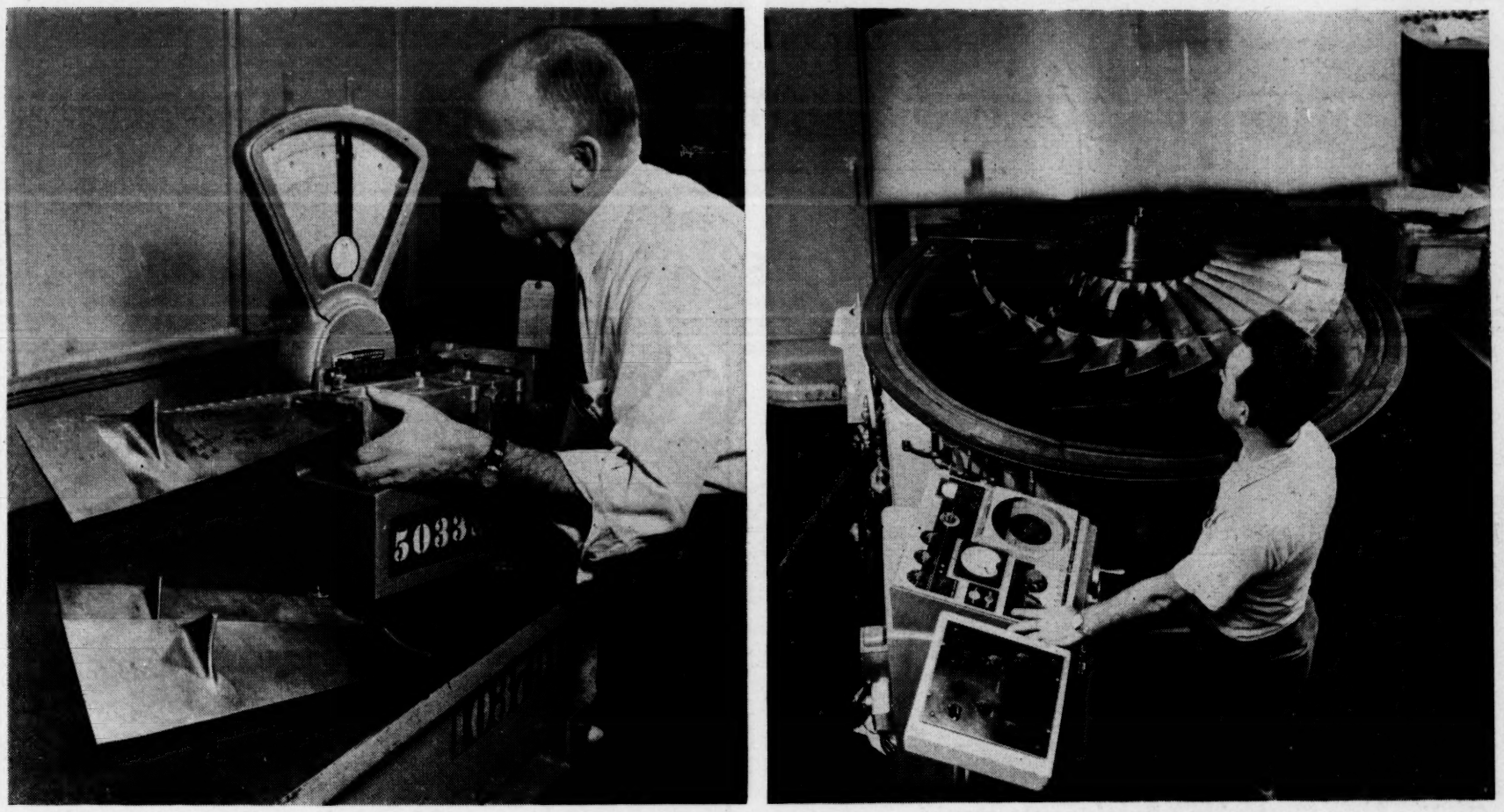


FAN BLADE is weighed at left; at right a fan section is checked in a balancing machine at Pratt & Whitney Aircraft.

stage turbine blades. Otherwise, there were no problems in the hot end of the JT4.

One minor problem was in the small bearing designated 4½ between the compressor and turbine rotors. It was a lubrication problem traceable to one airline only and to use of oil from a new vendor to that airline. The customer changed the type of oil and lubrication improved to standard.

There were bearing problems. No. 1 bearing at the front of the low pressure compressor was showing scavenging difficulties in its lubrication system. The trouble originated with the seal material which broke down. The seals were changed and scavenging returned to normal.

On the No. 4 bearing at the rear of the compressor there were leaks in the oil seal. These carbon seals became temperature problems. Two fixes were made. Improved quality of carbon gave the first incremental fix, and improved cooling of the bearing by changing the plate design completed the cure.

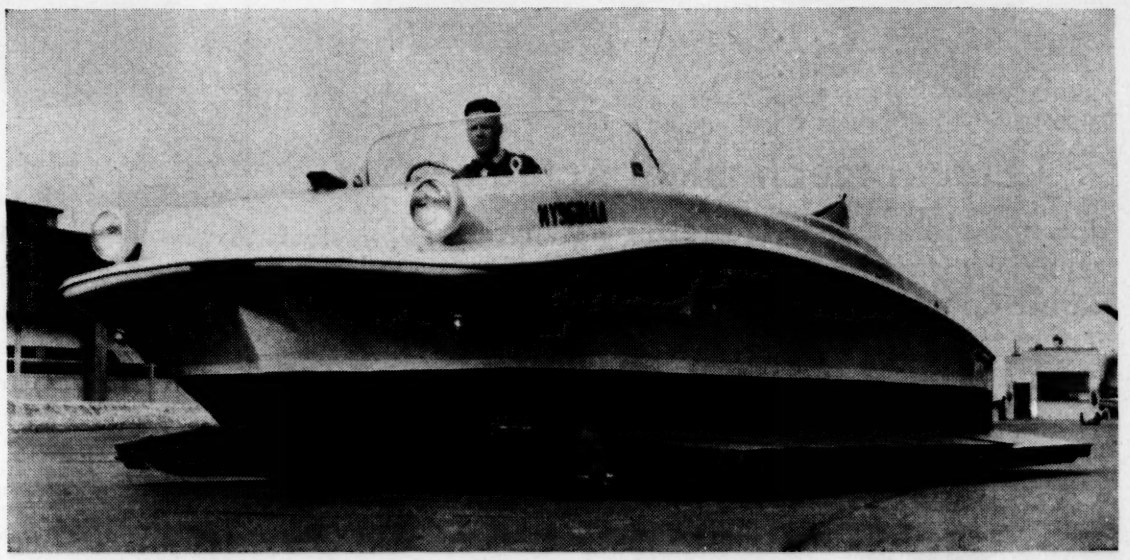
The tachometer drive gear on the JT4 engine came loose on occasion, and spun without turning the tachometer shaft. This was fixed by tightening the connection.

A major factor in reporting and fixing customer troubles is Pratt & Whitney's service representative field service organization operated by the company, which has long been envied and even copied by other commercial outfits. With only a few loud detractors, this group has won praise from Pratt & Whitney customers all over the world.

This department is the company's best source of information about service troubles. Pratt & Whitney decided early in the business not to rely on government sources for feedback, recognizing that time and routine worked against complete coverage of difficulties by the military. Instead, the company relies heavily on reports of field service men and frequently is able to take corrective action before a formal complaint is received.

Close coordination between engineering and field service is another factor which the company feels contributes to the commercial record of its engines. There is a group in field service charged with the responsibility of keeping engineers informed. Information flow in the other direction is the responsibility of project engineers, who are responsible for all phases of the engine from design through successful operation. It is no secret at Pratt & Whitney that the professional future of a project engineer depends in great measure on his ability to ride herd on the operational phase of an engine's life.

Annual maintenance meetings, bringing together overhaul outfits, field service people and project engineers, is another approach to better operations of Pratt & Whitney engines. This is not unique to the company, since this type of meeting has been standard among many segments of the powerplant, accessory and airframe industry for years. But Pratt & Whitney feels that this routine approach, coupled with the other means of intercommunication that link users, operators, designers, overhaul shops, field service and maintenance technicians, gives the company operational data on its products that it could get in no other way.



Bell ACV Licensed for State Roads

Bell Aerosystems Co.'s air cushion vehicle, first to be licensed for operation on state roads, is powered by a 65-hp. Porsche engine driving a fan mounted behind the driver and passengers. Bell's ACV weighs about one ton. Control system uses stick, wheel and rudder pedals. Operational height is about three inches off the surface.

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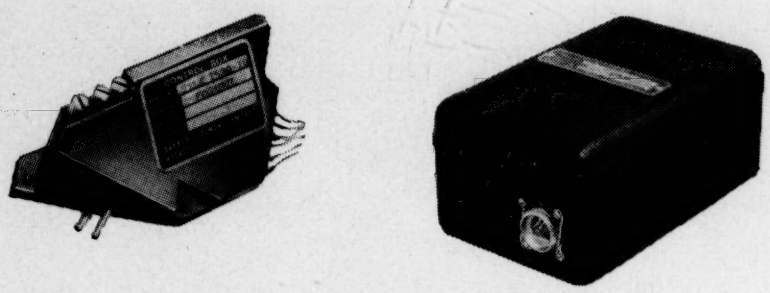

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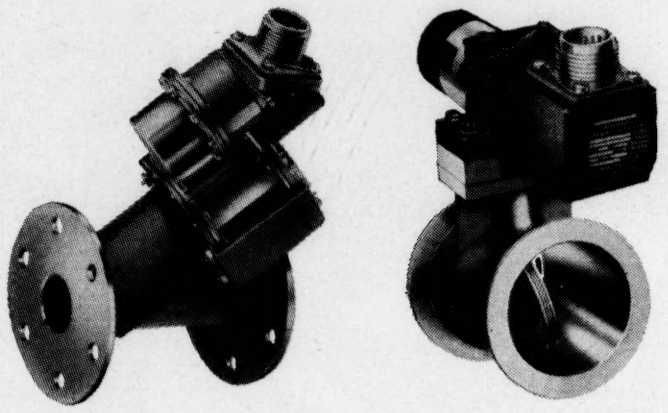

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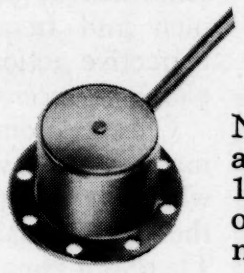

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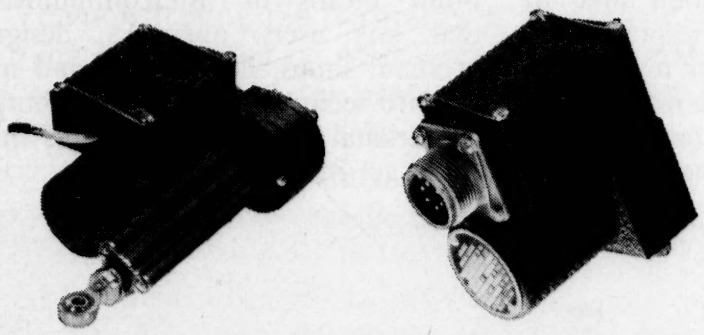

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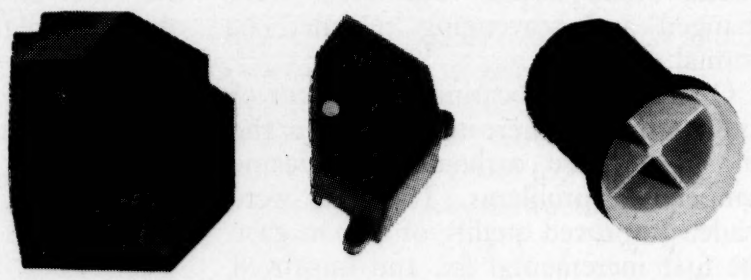

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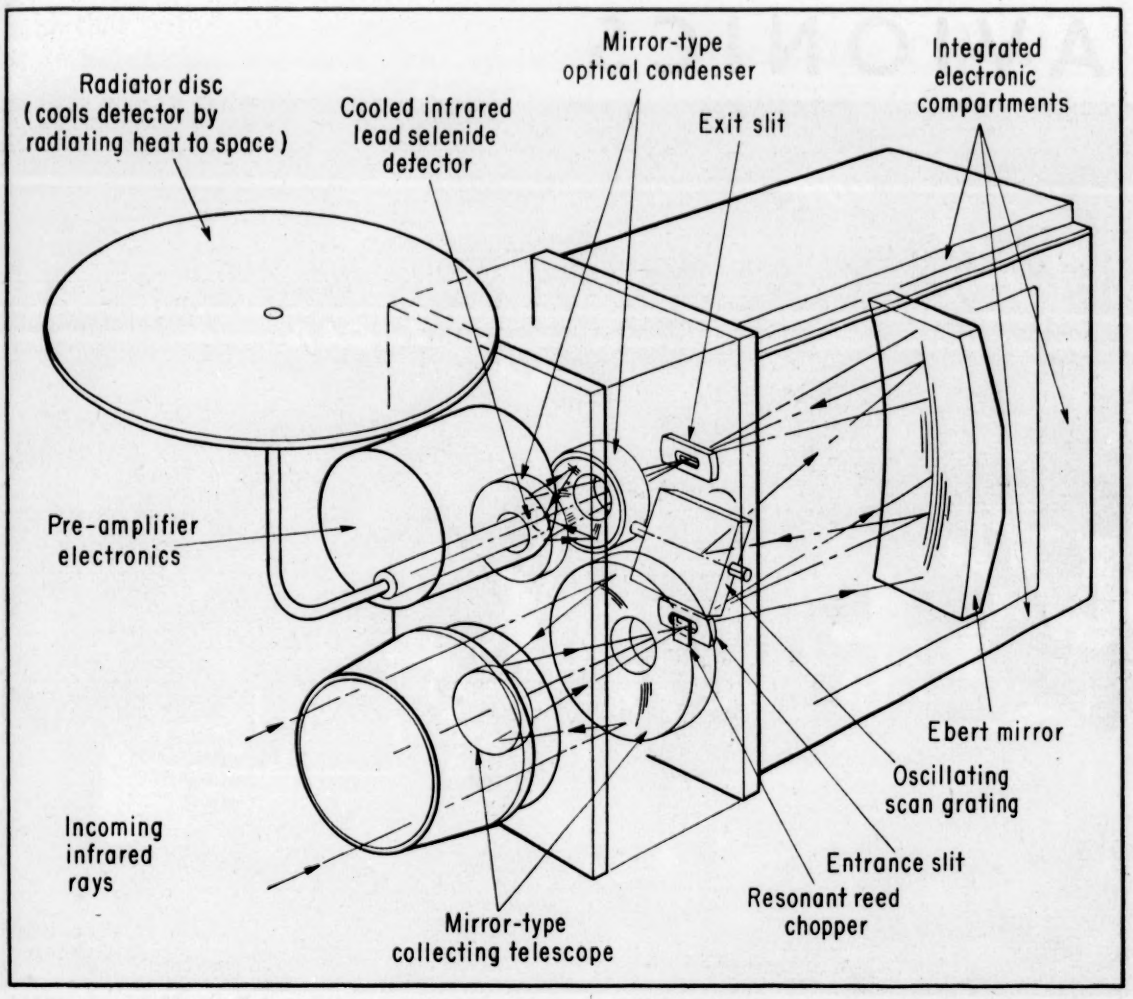

INFRARED spectrophotometer built by Perkin-Elmer Corp. for NASA's Mariner space vehicle will investigate existence of vegetation on Mars. Instrument is 10 in. high, 6 in. wide, 18 in. long and weighs about 20 lb.

Spectrophotometer to Investigate Existence of Vegetation on Mars

New York—Existence of vegetative life on Mars will be probed by an infrared device aboard the National Aeronautics and Space Administration's Mariner space vehicle during a 1964 fly-by.

Spectrophotometer instrument, designed and built by the Perkin-Elmer Corp., Norwalk, Conn., will measure radiation absorption in the 2-4 micron region to corroborate indications received by the Mount Wilson, Calif., observatory that absorption on Mars occurs around 3.5 microns—the energy level at which lichen and some forms of desert weeds assimilate radiation on earth.

5-hr. Fly-by Time

Mariner is expected to pass within 9,000 to 37,000 mi. of Mars and fly-by time is estimated at about 5 hr. The Perkin-Elmer instrument will scan an area 40 by 400 mi., overlapping each scanned area so that 50-60% of the Martian surface will be analyzed.

Solar radiation reflected from the planet's surface enters the spectrophotometer through a 4-in.-aperture telescope and is imaged on a .25 x 2.5 deg. entrance slit. A reed chopper, oscillating at 300 cps. between the telescope and entrance slit, modulates the incoming radiation. Passing through the slit, the now-modulated radiation is bounced off a concave mirror onto a rotating, pivot-mounted scan grating. The grating diffracts the radiation into spectral wavelengths and reflects it back onto the mirror. Grating's instantaneous angle of incidence reflects only one wavelength at a time on a .04 x .4 in. exit slit. Behind the exit slit, an ellipsoid mirror focuses the particular wavelength on a lead selenide detector.

Data Telemetered

Signals are picked off by an automatic gain-controlled preamplifier, amplified, demodulated and fed to an analog-digital converter. The binary-coded output is then compressed for telemetry transmission.

The selenide detector is radiantly cooled to −78C in order to achieve infrared sensitivity.

A small aluminized shielding on one side of the detector blocks sunlight, leaving the other side open to the cold of space.

Perkin-Elmer has already delivered one spectrophotometer to NASA's Jet Propulsion Laboratory, Calif., for study and evaluation.

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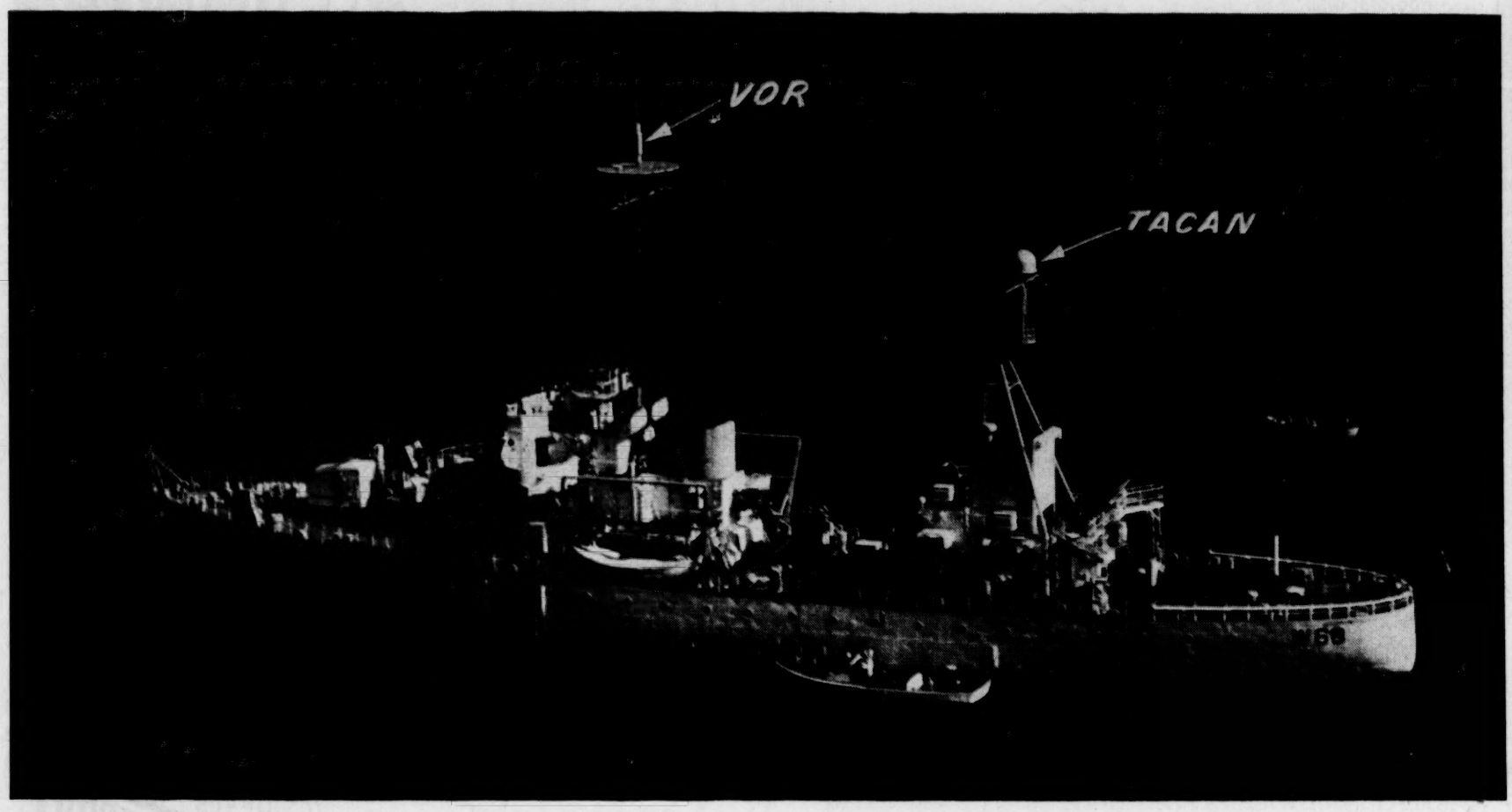


TRANSOCEANIC navigation system, using several shipboard Vortac installations like one shown here on Coast Guard cutter Androscoggin in combination with airborne doppler navigators, could provide increased navigation accuracy at moderate cost with no additional equipment required in the aircraft, according to the FAA. Androscoggin is now on Station Charley in North Atlantic.

FAA Reports on Transatlantic Vortac Aids

By Philip J. Klass

Atlantic City, N. J.—Two or three ship-based Vortac stations may be able to provide a 340-380-naut.-mi.-wide navigation corridor across the North Atlantic, enabling aircraft equipped with doppler navigators to establish their position with an accuracy better than 8.6 naut. mi., according to preliminary results of a Federal Aviation Agency analysis.

First report on the results of an FAA investigation was made here by Nathaniel Braverman and S. R. Anderson of FAA's Bureau of Research and Development during its recent International Aviation Research and Development Symposium, attended by representatives of 25 countries.

Favorable Aspects

System is expected to get a favorable reaction from international carriers because it would require no additional airborne avionics equipment, beyond the VOR, DME and doppler navigators which they already have or plan to install. Most military aircraft operating over the North Atlantic also are outfitted with doppler navigators and Tacan or VOR-DME.

Principle of the new system's operation is very simple: The Vortac stations would serve as periodic fix points to correct accumulated errors in the doppler navigator, as well as providing direct navigation service while an aircraft is in the vicinity of the station.

Preliminary flight tests to determine the feasibility of ship-based Vortac recently were conducted by FAA using an experimental installation aboard the Coast Guard cutter Androscoggin operating off the Florida coast. More recently, the Androscoggin has gone on duty in the North Atlantic at Station Charley where its Vortac service can be used and evaluated by international carriers.

Braverman emphasized that his report was an interim one based on a "first-order accuracy analysis" conducted by BRD's Research Division. The study is part of its analysis of several possible long-distance navigation aids.

In the absence of extensive data on the accuracy of existing airline doppler navigators in over-water operations and the accuracy of ocean-based Vortac stations at the time the analysis was started, Braverman said the study assumed the following accuracies:

- **VOR-bearing:** 95% of the omnirange azimuth readings are expected to have errors of less than 5 deg.
- **DME-distance:** 95% of the distance readings obtained should have errors of less than 1% of the distance from a Vortac station.
- **Doppler distance:** 95% of the along-course distance readings should have errors less than 1.5% of distance traveled, while 95% of the cross-course data is expected to have an error of less than 4% of distance traveled.

For the initial analysis, FAA adopted a goal of 8.6 naut. mi. as the maximum tolerable error in position between Newfoundland and Ireland, which is half of the 17.2-naut.-mi. maximum uncertainty of position now believed to exist over the North Atlantic.

Number of Stations

Based on these assumptions, the preliminary analysis indicates that using two Vortac stations, separated by 575 naut. mi. from each other and from land, could provide a 340-naut.-mi. wide corridor across the North Atlantic in which the maximum error would not exceed 8.6 naut. mi.

If three Vortac stations were used, separated by 430 naut. mi., the width of the corridor would be increased to 380 naut. mi., Braverman said.

Emphasizing the value of the airborne doppler navigator, Braverman

said that without it, five ocean-Vortac stations, each 290 naut. mi. apart, would be needed to provide a navigation corridor of the same width and accuracy.

Based on the assumed values of VOR, DME and doppler error, the switchover from doppler to Vortac data should be made soon after the airplane comes within range of an ocean-Vortac. Shortly after passing the station and resetting the doppler equipment, the latter should take over as the primary navigation aid until the aircraft comes within range of the next Vortac, FAA's analysis indicates. However, the point of switchover from doppler to Vortac and back is not critical in its effect on over-all system accuracy.

The 340- and 380-naut.-mi. corridors with errors of less than 8.6 naut. mi. initially were determined on the assumption that aircraft would be flying a course parallel to a line connecting the ocean-Vortac stations. Because aircraft do not actually fly such rigid flight paths, the next analysis was based on non-parallel flight.

Within Allowable Error

These studies indicated that maximum errors anywhere in the navigation corridor could not exceed 8.6 naut. mi., regardless of the airplane's flight path. For any particular aircraft position in the corridor, its position fix error might be slightly higher or lower than if it had flown to the same point by a parallel-to-station flight path. But in no case should the error exceed the 8.6-mi. figure, Braverman said.

Although there is no question but that the use of a ship-based Vortac for periodic correction of doppler navigators would improve trans-ocean navigation accuracy, it is not certain that the VOR-bearing errors on a ship-based installation can be held to the 5-deg. value used in FAA's analysis.

The tests which FAA conducted with the Androscoggin off the Florida coast were very meager and without extensive instrumentation, intended only to provide a gross indication of the feasibility of ocean-Vortac installations.

With the VOR antenna installed on a mast that put it 84 ft. above water level, energy reflected from the water combines in an out-of-phase condition with the direct-radiated energy to produce areas of no signal, or "nulls." When an aircraft flies through one of these nulls, its course deviation indicator will swing back and forth, as much as full scale.

One of the purposes of the Florida tests was to determine the severity of these nulls and how system performance is affected by a ship's rolling in rough seas.

For an aircraft flying at 10,000-ft. altitude, the first null is encountered at a distance of about 30 naut. mi. from the Vortac station. In FAA flight tests, a C-54 flown at this altitude experienced a bearing (course) roughness of plus or minus 1 deg. until it encountered the first (lowest) null, where the bearing variation increased to 2 deg. In the heart of the null, for a distance of about 4 mi., the variation in bearing indication ran as high as plus or minus 10 deg., Anderson reported at the symposium.

In high altitude flight tests, conducted with a KC-135 at 40,000 ft., FAA found a course roughness of about plus or minus 1.5 deg. for VOR, and 2 deg. for Tacan azimuth indication. Variation in sea states appears to have little effect on ship-based Vortac performance, Anderson said.

The Vortac installation on the Androscoggin incorporates heading stabilization to compensate for changes in ship's heading by automatically changing the relative phase between the reference and variable phase VOR signal.

Ship Identity

Because a weather ship does not remain anchored while on station, but cruises over a confined area, it is necessary to advise aircraft using its Vortac facilities of the ship's position at that instance. For this purpose, each ocean station is divided into 441 10-mi. squares, each assigned a two-letter identification code. The Vortac keyer which transmits the station's identification in Morse code also transmits this two-letter code indicating the ship's position.

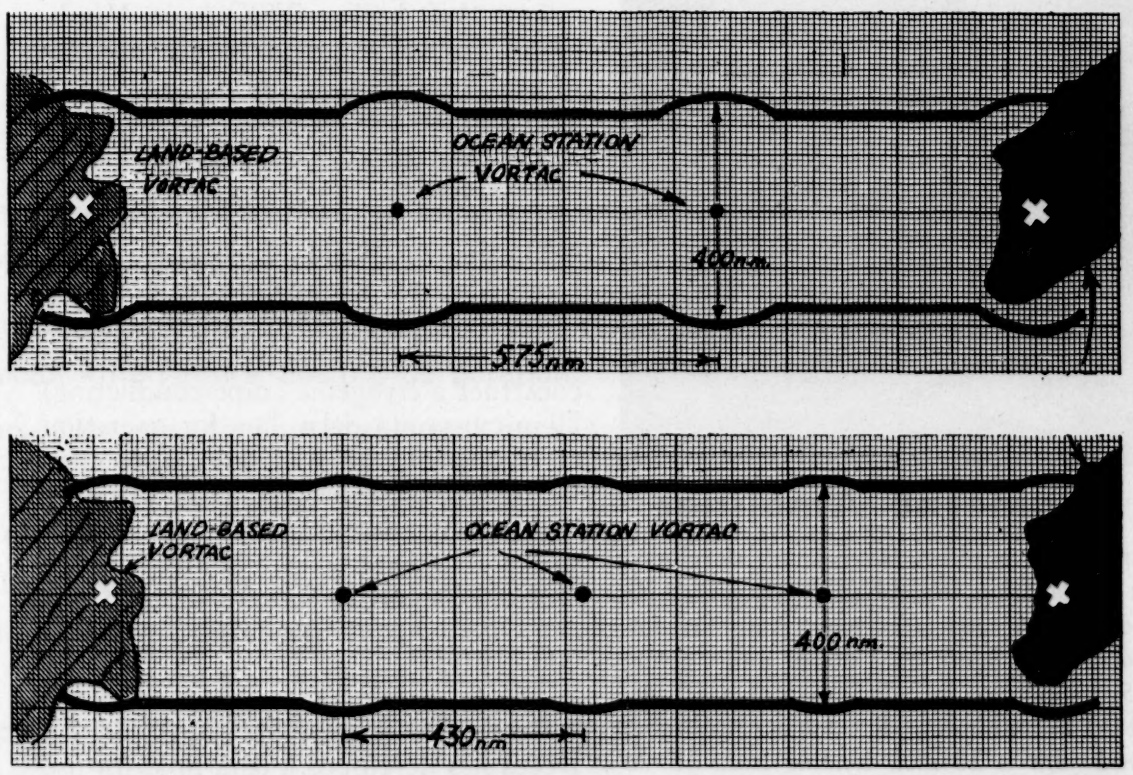
To reduce nulls in coverage and minimize course roughness caused by ship rolling, an ocean-Vortac could be mounted on a buoy which would be anchored to the ocean floor. Under 30-ft. wave conditions, the maximum roll angle of the buoy would be about 6 deg., compared with 50 deg. for an ocean station vessel, Anderson said. Further, the antenna could be located

Supersonic Control

Atlantic City, N. J.—Traffic control of supersonic airliners operating over the North Atlantic may require them to fly a constant altitude and at other than optimum cruise altitude, increasing direct operating costs by 5-10%, according to preliminary studies made by British Royal Aircraft Establishment. Results of these studies were reported here by P. G. Reich at the Federal Aviation Agency's recent International Aviation Research & Development Symposium.

The RAE study assumed a five-fold increase in North Atlantic passenger traffic by the mid-1970s, when supersonic transports might be operating. Based on an average seating capacity of 100 passengers, the study concludes that there will be 25 aircraft movements per hour in each direction.

Generous time separations will be required for supersonic transports on the same flight path because of uncertainties over how accurately their speed can be controlled, Reich said. Aircraft experiencing failure of navigation equipment would be required to descend to a lower emergency altitude band in which there was no other traffic, unless suitable airborne collision avoidance systems can be devised to provide required protective airspace.



AREA COVERAGE which could be provided by two or by three ocean-based Vortac stations used in combination with airborne doppler navigators to give navigational fix having error of less than 8.6 nautical miles. Use of three ocean stations increases navigation corridor width from 340 naut. mi. to 380 naut. mi., FAA analysis indicates.

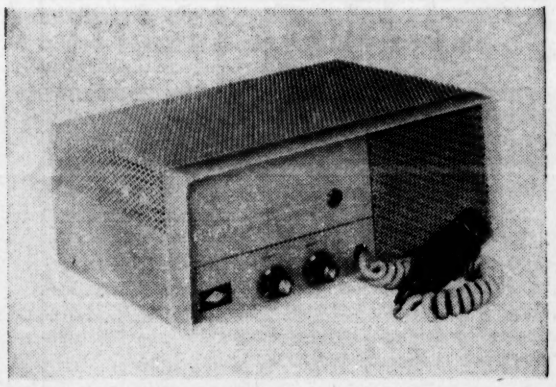
at a height of only 26 ft. instead of the present 84 ft., reducing the null problem. Anderson conceded that the need for continuous, unattended operation would require a high order of state reliability.

FAA scientists privately express the view that with the use of newer antenna techniques, and other design improvements not attempted on the quick-and-dirty Androscoggin installation, improved VOR and Tacan bearing accuracy should be possible.

FILTER CENTER

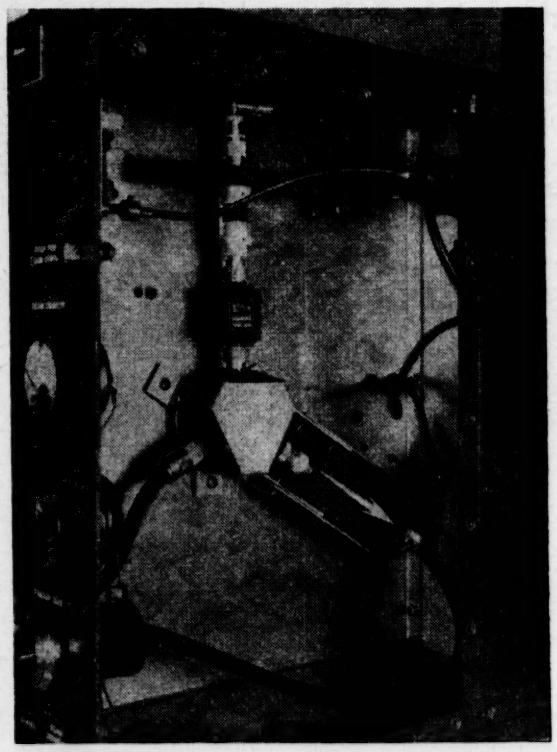
▶**Low-Noise Radar Tube Developed**—Traveling wave tube which has demonstrated noise figure of less than 3 db. over large portion of S-band in laboratory tests, has been developed by RCA Electron Tube Division, Harrison, N. J., under Air Force sponsorship for possible use in anti-ICBM radars. Development samples in L-band and S-band are being supplied with guaranteed maximum noise of less than 5 db., RCA says.

▶**Soviet Hedges Claims on "Kabanov Effect"**—Nikolai Kabanov, who recently claimed discovery of back-scatter of high frequency radio waves from earth and ionosphere now concedes that non-Soviet scientists had several "almost-correct" answers to long-range backscatter and gives credit to western achievements in more recent years. United States Air Force was sponsoring research and hardware programs utilizing HF backscatter at least 10 years ago, reported in AVIATION WEEK in 1953, while Soviets have only recently announced their "discovery," claiming experiments as early as 1946-47 (AW Jan. 16, p. 97). Kabanov says that return signals were obtained over distances of about 2,000 mi. using transmitter powers of several kilowatts at 5.5 to 20 mc. With higher powered transmitters and higher gain antennas, ranges of nearly 8,000 mi. were obtained, Kabanov says in article that appeared in Radiotekhnika i elektronika, October, 1960.



Aircraft Communicator

Aircraft communicator, for two-way voice communications with aircraft or control tower, covers 108 to 136 mc. band. Model G-150 is available for operation from 6, 12, or 28 v.d.c. or from 115 v.d.c. Manufacturer Gonset Div., Young Spring & Wire Corp., 801 South Main St., Burbank, Calif.



Parametric Amplifier

Parametric amplifier for L-band, developed for installation in AN/TPS-1D, TPS-1G and FPS-36 radar receivers. Amplifier improves noise figure by 2 db. or more, giving a 50% increase in radar range or a 5:1 decrease in minimum detectable target size. Bandwidth is 10 mc., tunable from 1.2 to 1.4 kmc. Model X-217 parametric amplifier was developed by Melabs, 3300 Hillview Ave., Palo Alto, Calif., under Signal Corps sponsorship.

▶**Moon-Bounce Relay Will Try SSB**—Navy will evaluate use of single sideband in comparison with existing frequency-shift keying (FSK) in its Washington to Hawaii moon-bounce communications system. Contract has been awarded to Development Engineering Corp., Leesburg, Va., to provide the new capability.

▶**Martin to Build Cryogenic Delay Line**—Martin Company's Electronics Division in Baltimore will investigate materials and techniques required to construct a cryogenic (superconducting) 20-microsecond delay line for operation at frequencies of 4-12 kmc. Objective is to develop a lossless delay line 15,000-ft.-long encapsulated in a 3-in. cube which is maintained at temperature of 4.2K. Program is sponsored by Rome Air Development Center under a $90,000 contract.

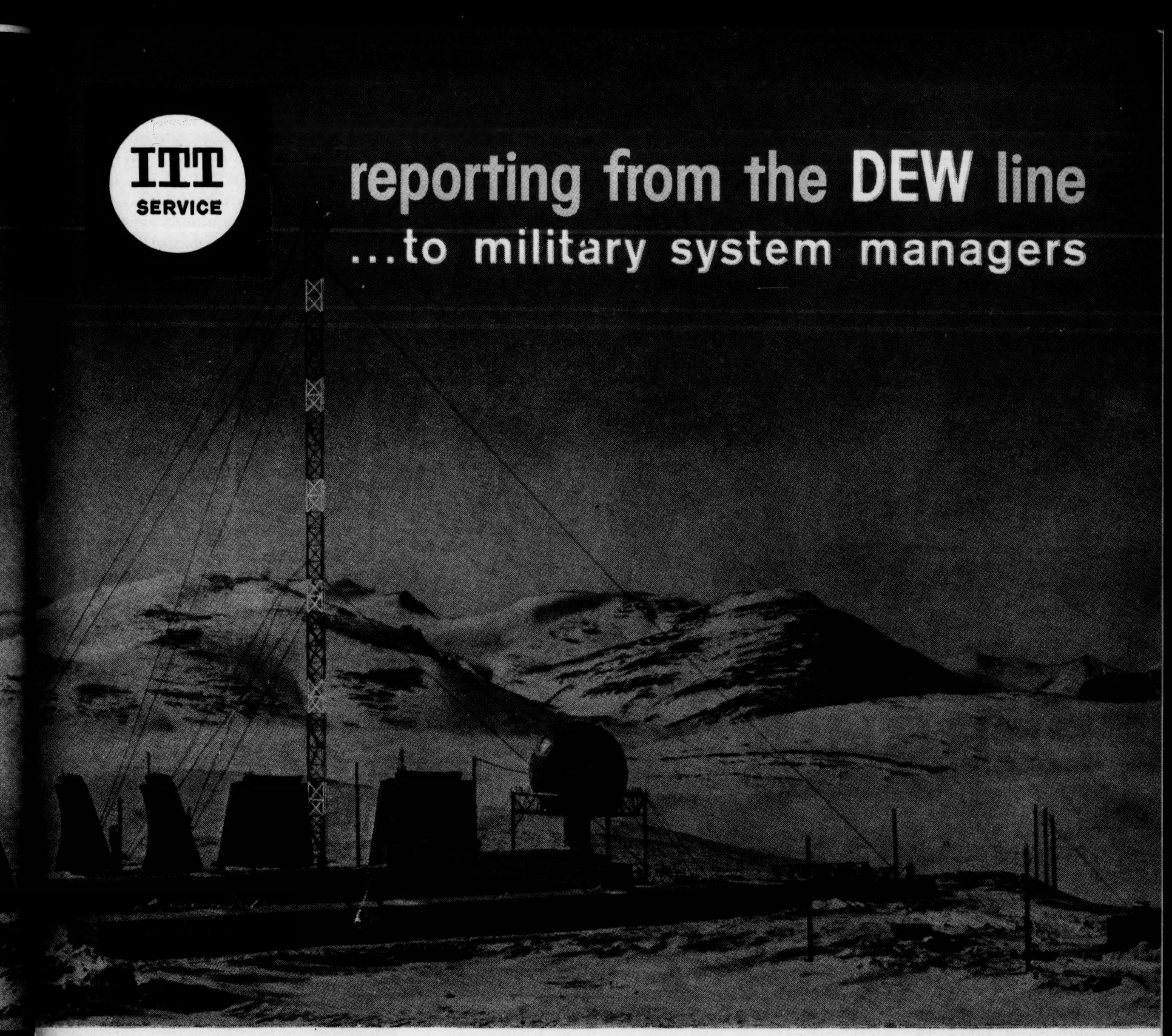
▶**Decca Develops Data Link**—British Decca has developed a data link, for use with its navigation receiver, which transmits position of aircraft automatically for display at an air traffic control center. Non-synchronous transmission tech-

. . . DEW Line spans over 1/3 of the arctic circle—is a key element in hemispheric defense.

Size and complexity of the DEW Line demand management experience in depth. Shown conferring are Col. A. J. Reynolds, USAF; J. W. Guilfoyle, President, FEC; Maj. Gen. Dale O. Smith, USAF; and R. H. Cruzen, Vice Pres., FEC.

ITT SERVICE

reporting from the DEW line
...to military system managers



...Our first line of defense against a surprise enemy attack from the north—USAF's 4,500-mile Distant Early Warning Line—is effective. No aircraft can fly across it without immediate detection.

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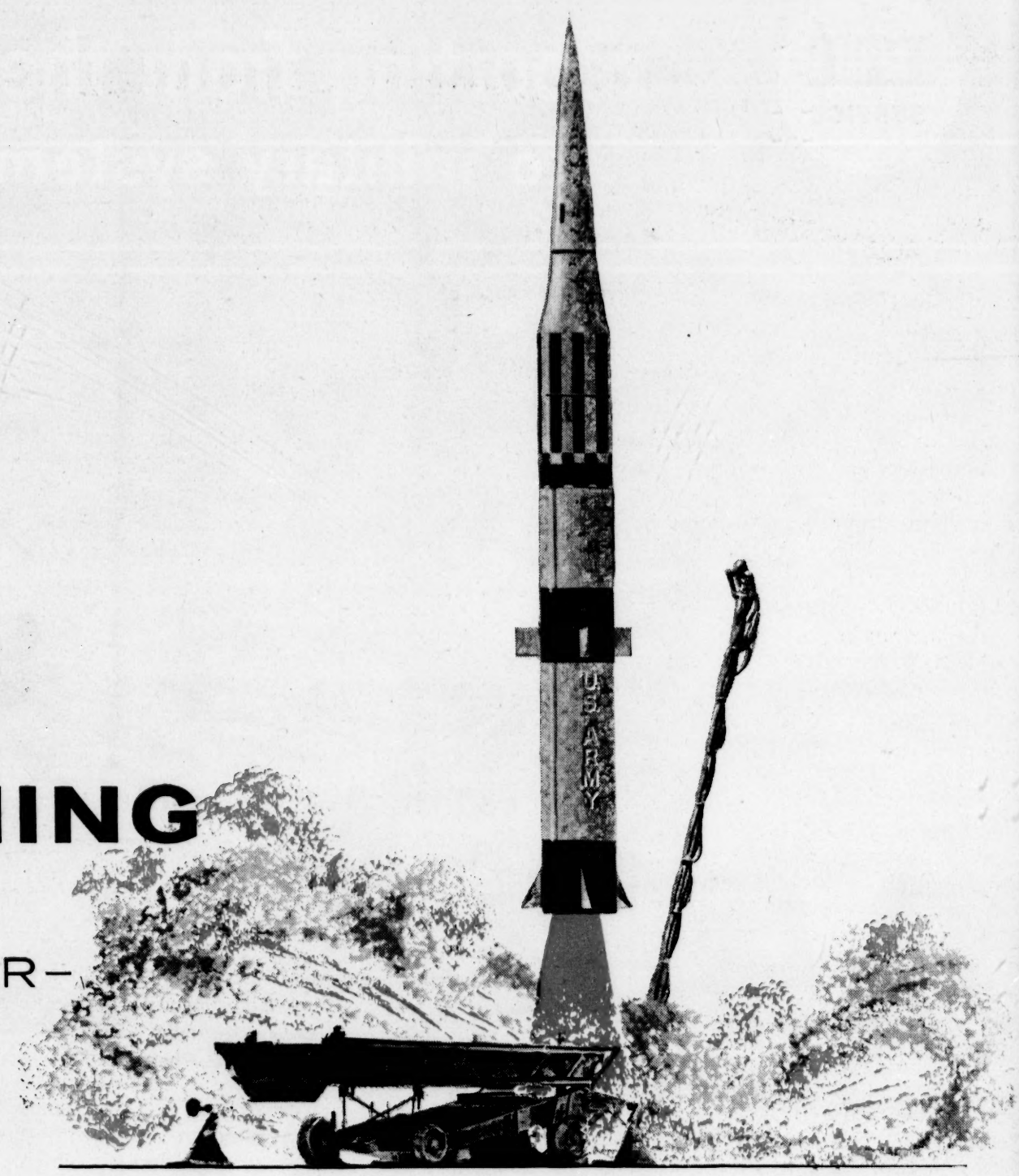

Pershing, the Army's newest, most advanced missile system, is being developed to provide artillery fire support to the Field Army. The unique tactical aspect of this missile is its exceptional battlefield mobility.

Pershing is mounted on a transporter-erector-launcher (TEL), an electro-mechanical system used to erect the missile into firing position, align it with the target azimuth, and support it accurately until fired. The lightweight TEL system can be deployed by standard military aircraft, and/or helicopter and tracked carrier. The tactical prototypes of the TEL which have been employed by the Army in all Pershing launchings to date were designed and manufactured by the TAPCO Group for The Martin Company, developers of Pershing.

TAPCO's extensive experience in designing, developing and producing subsystems is one reason we are part of such programs as Pershing; and Advanced Terrier, Tartar, Minuteman, Bomarc, Bullpup, Sidewinder and Polaris.

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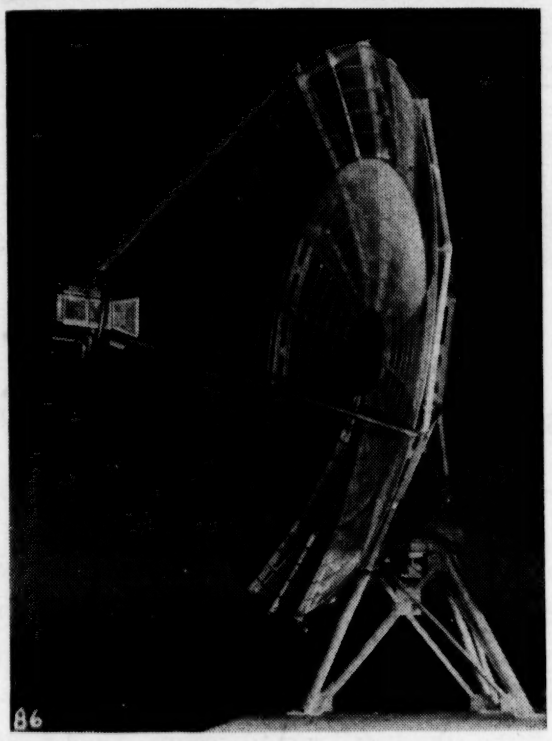
nique is employed and data can be sent at any desired rate, company reports. When received on the ground, information can be fed into computer, displayed on cockpit type flight log or a cathode ray tube display. Company reports that initial experiments show system to be "highly successful" and that further work has been ordered by the Ministry of Aviation.

▶ **Test Generator Standardization Studied**—Capehart Corp., Richmond Hill, N. Y., has received a Signal Corps contract to analyze all signal generators now used by Defense Department maintenance and overhaul facilities and make recommendations for modifications required to minimize number and variety of such equipments required by military services. Contract is for $18,000.

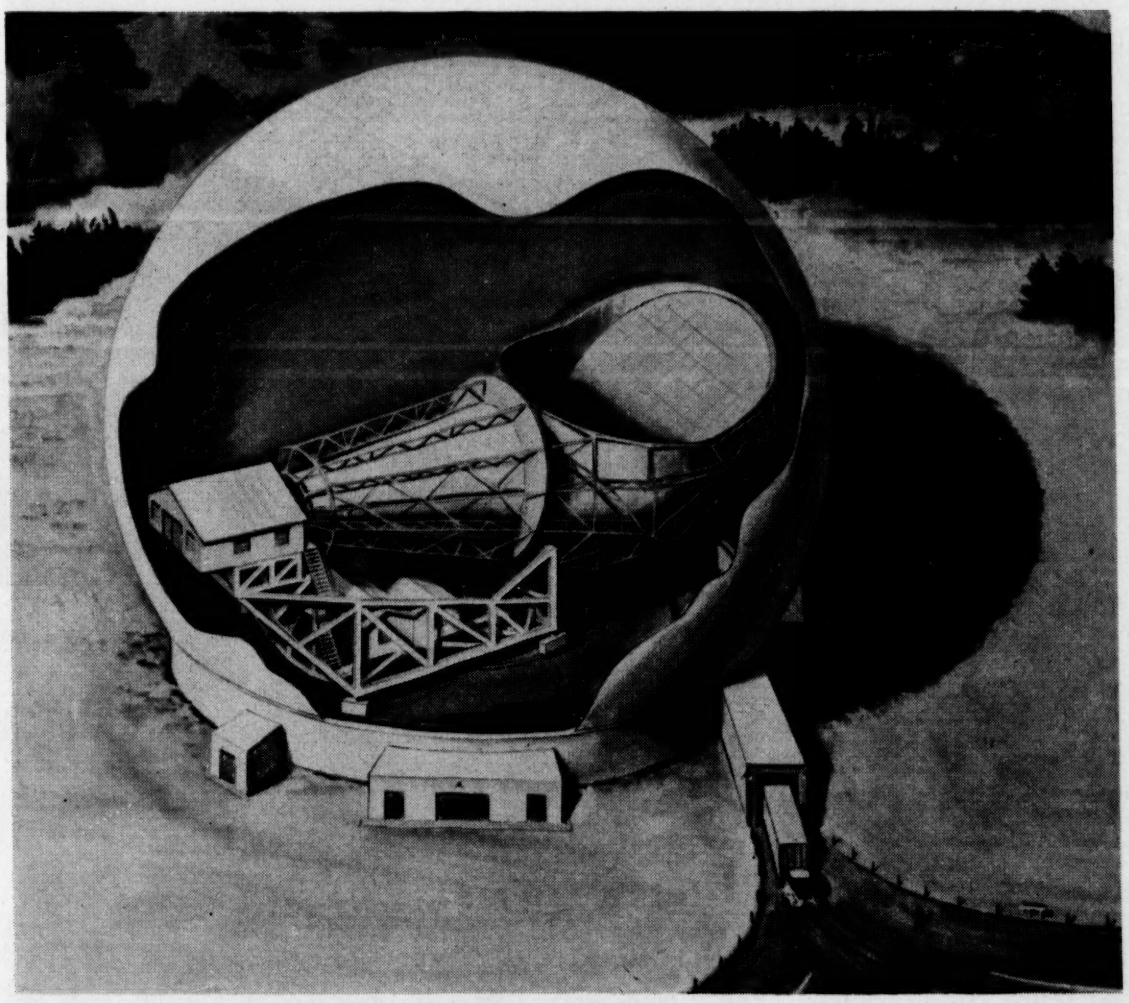
▶ **Lightweight Atomic Clock Developed**—An airborne atomic frequency standard, weighing only 62½ lb., which is accurate to within one part in 10 billion and stable to within one part in 25 billion, has been developed by the National Co., Malden, Mass., for Wright Air Development Division. Device, employing a cesium-beam resonator, is the smallest atomic clock developed to date. Early laboratory models, developed by National Co., weighed about 600 lb.

▶ **NBS to Provide Luminance Standards**—In response to requests for a precise means of evaluating the brightness of aircraft instrument dials and panels, the National Bureau of Standards has launched a program to provide luminance standards. These consist of a diaphragmed flashed opal glass and an electric lamp, together with a calibration report containing instructions for their use. Standards are available at prices ranging from $63.00 to $72.00 from the Photometry and Colorimetry Section, National Bureau of Standards, Washington 25, D. C.



ALRI Antenna

Steerable 28-ft. parabolic antenna, one of four built for use with AN/GSC-7 high-power data link for communicating with Airborne Long Range Input (ALRI) early warning aircraft and feeding their data into SAGE system. Antenna was built by Gabriel Electronics for Electronic Communications, Inc., which is building GSC-7 ground stations under Burroughs Corp. subcontract.



AT&T to Build Satellite Communication Antenna

Huge sensitive horn antenna, for use in communication satellite experiments, will be constructed by American Telephone & Telegraph Co. near Rumford, Me. The new antenna, a larger version of antenna constructed by Bell Telephone Laboratories at Holmdel, N. J. for Project Echo communication satellite tests, will measure 177 ft. long and 94 ft. high. Antenna, which will be used both for transmission and reception, will be housed in an air-inflated radome, measuring 210 ft. wide and 161 ft. high. New AT&T facility, which will cost $7 million, is slated for operation early next year. The site in Maine was selected because it is surrounded by mountains which will minimize danger of interference with other microwave radio services. The horn-shaped antenna configuration minimizes sidelobes for greater signal sensitivity.

▶ **Signed on the Dotted Line**—Major contract awards announced recently by avionics manufacturers include:

• **Bell Aerosystems Co.,** Buffalo, N. Y., will build 12 AN/SPN-10 automatic landing systems for installation aboard 10 Navy aircraft carriers and at two land bases for training aids. First installation will be aboard the nuclear-powered USS Enterprise. Contract value will exceed $10 million, company says.

• **Magnavox Corp.,** Ft. Wayne, Ind., Navy contract for $10.5 million for production of anti-submarine warfare radar units for use on P2V and P3V ASW aircraft.

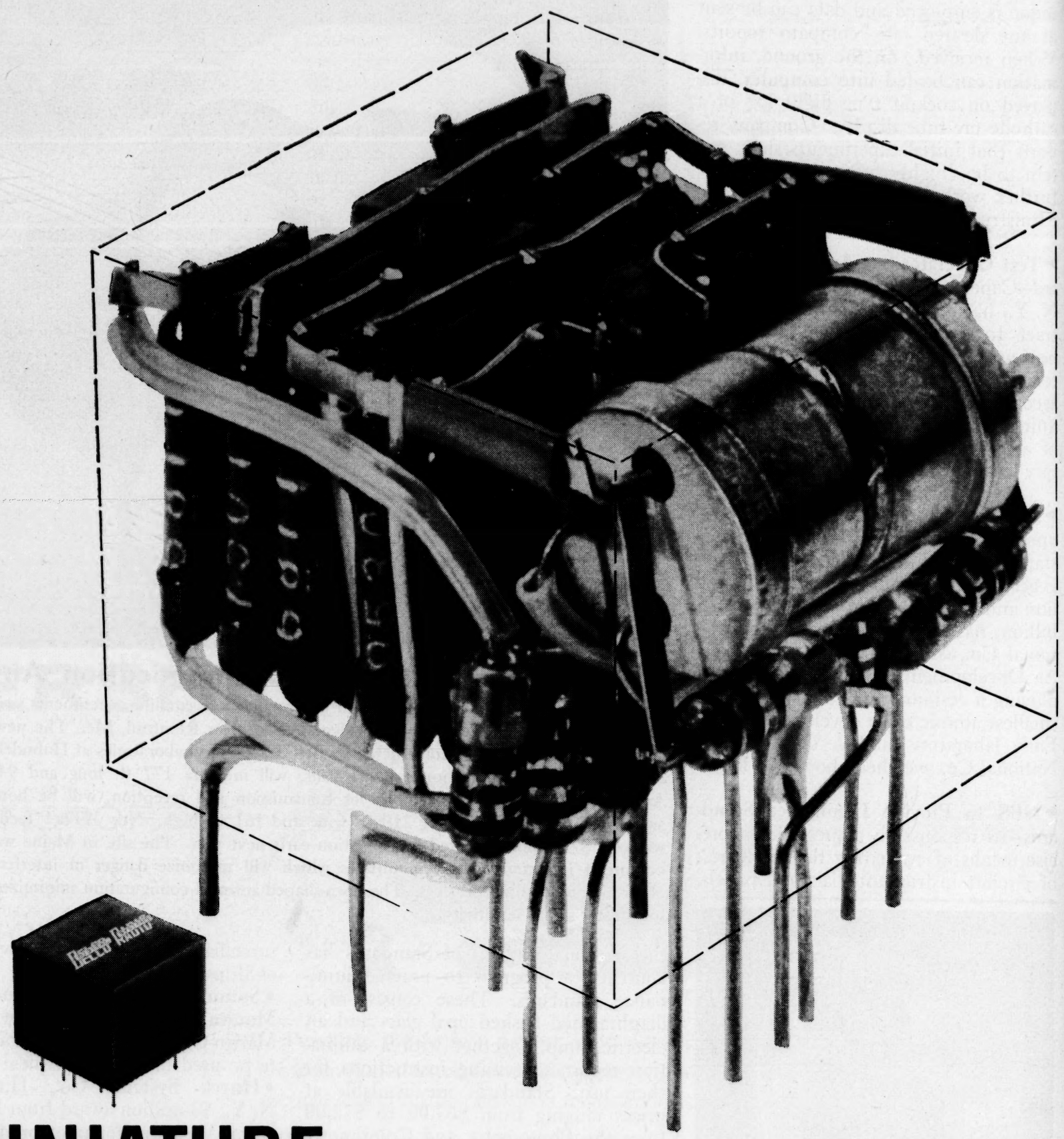
• **Servonics, Inc.,** Alexandria, Va., will manufacture company-developed automatic track-while-scan system for use by surveillance radars under Navy Bureau of Ships contract.

• **Summers Gyroscope Co.,** Santa Monica, Calif., $125,000 award from Martin-Orlando for spring-wound gyros to be used in trainer missiles.

• **Huyck Systems Co.,** Huntington, N. Y., $3-million award from Bureau of Naval Weapons for pilot production of company developed AN/ASN-30 tactical ASW display and computer system for Grumman S2F-3. System displays input data from anti-submarine detection equipment, showing target location, as well as basic dead reckoning navigation information.

• **Collins Radio Co.,** Cedar Rapids, Iowa, $1.3-million contract for production of AQU-2/A horizontal situation indicators for Air Force twin-jet trainers. Company also reports $524,000 contract from USAF for HF-101 airborne single sideband HF communication transceivers and accessories.

• **American Electronics, Inc.,** Los Angeles, $614,000 in contracts, most of which covers precision regulated motor-generator sets for use at Minuteman ICBM hard sites and mobile re-entry vehicle trailers for support at Minuteman and Titan hard sites.



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Delco Radio's high density packaging of reliable standard components utilizes the unique three-dimensional welded wiring technique. These miniature modules are available off the shelf in 16 basic types. Or with them, Delco Radio can quickly build for you a compact, reliable digital computer for airborne guidance and control or any other military application. Vacuum encapsulated with epoxy resin, the modules perform all the standard logic functions. They meet or exceed all MIL-E-5272D (ASG) environmental requirements, and operate over a temperature range of −55°C to +71°C. Too, these same reliable digital circuits are available packaged on plug-in circuit cards. And we can also supply circuits to meet your specific needs. For complete details, just write our Sales Department. *Physicists and electronics engineers: Join Delco Radio's search for new and better products through Solid State Physics.*

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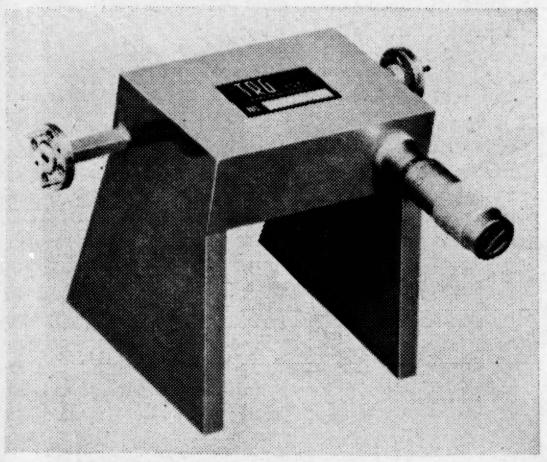
NEW AVIONIC PRODUCTS

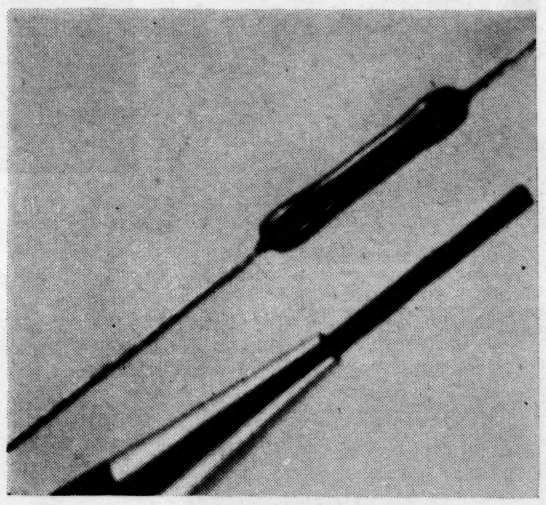
• **Millimeter band tunable ferrite isolator,** called Ferrimat, available for "A", "V" and "E" bands, operates over full waveguide frequency range. Typical performance figures are VSWR of 1.25 maximum, isolation of 20 db. minimum



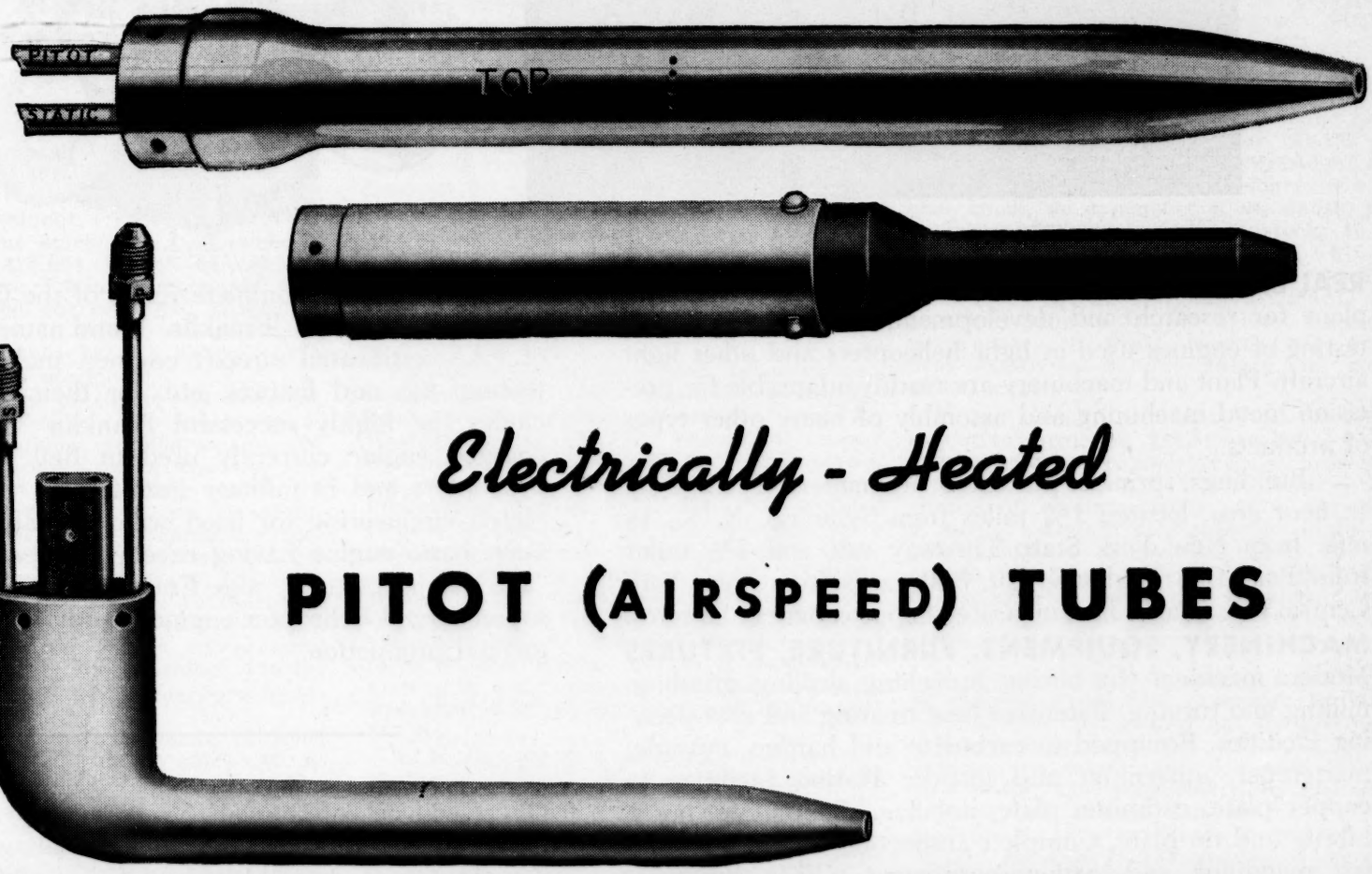
and loss of 1½ db. maximum. Isolator for "F" band is now under development. For additional application data, write manufacturer: Technical Research Group, Inc., Antenna & Microwave Dept., 9 Union Square, Somerville, Mass.

• **Subminiature trimming potentiometer,** Model 358, for printed circuit board use has height-off-the-board dimension of only 0.195 in. and measures ½ in. square. Potentiometer is available in resistances of 10 ohms to 50,000 ohms for operation over temperature range of −55C to 200C, with power rating of 1 watt up to 50C, derating to zero at 200C in still air. Resolution at 50,000 ohms is 0.086%, according to manufacturer: Daystrom, Inc., Potentiometer Div., Archbald, Penna.

• **Resistor, wirewound,** vitreous-enameled, axial-lead power unit rated at one watt, measures ⅛-in. maximum diameter, 9/16-in. maximum length. Presently these resistors are being made to order in 5% tolerance, 1- to 6,000-ohm range. Additional information in Bulletin 147 available from the manufacturer, Ohmite Mfg. Co., 3657 Howard St., Skokie, Ill.



• **Underwater transducer** will operate at water pressures up to 60 psi. and over a frequency range from 10 cps. to 10 kc. Below resonance, response is constant −82 db. reference 1 volt per microbar. Transducer is substantially nondirectional over normal frequency range and can be used as a transmitter or as a receiver. With 60 ft. of cable the transducer weighs 11 oz. when using brass pistons to drive piezoelectric disks for converting sound to electrical energy. With aluminum pistons the transducer scales 9 oz. Manufacturer: Clevite Ordnance Division of Clevite Corp., 540 East 105 St., Cleveland.



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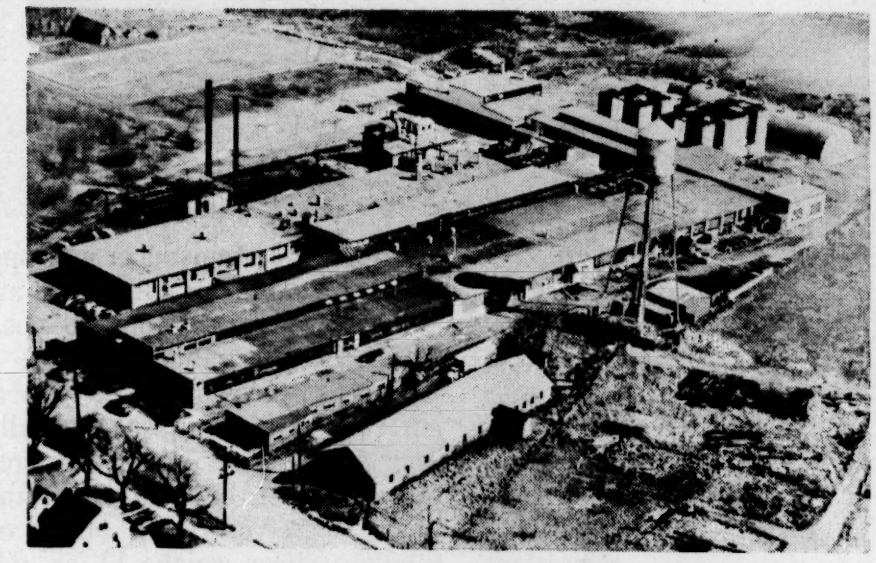
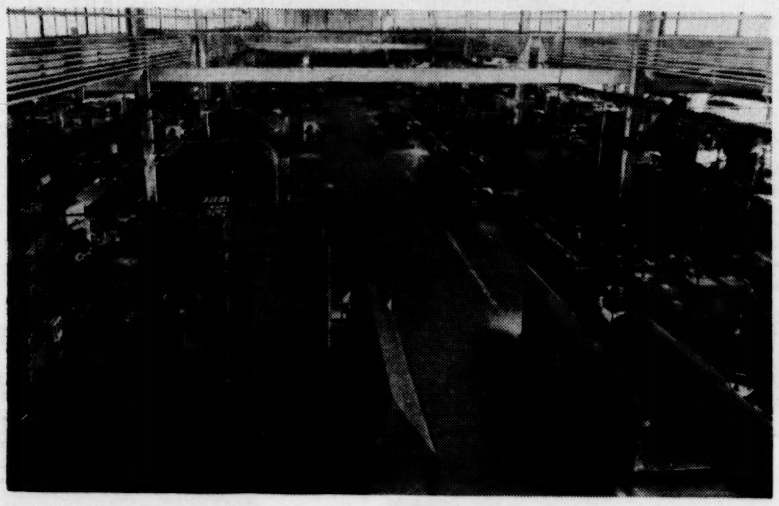
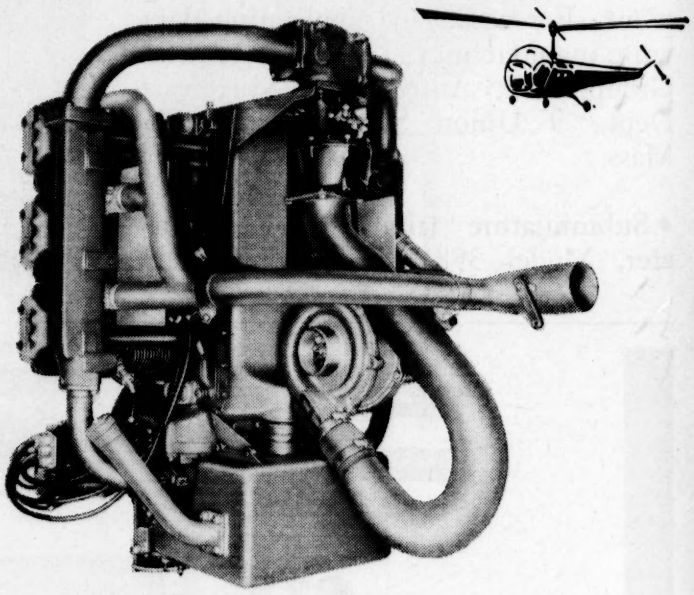






REAL ESTATE Probably the country's finest specialized plant for research and development, manufacturing and testing of engines used in light helicopters and other light aircraft. Plant and machinery are readily adaptable for precision metal machining and assembly of many other types of products.

Buildings, sprinkler protected, are modern, 130,882 sq. ft. floor area, located 1¾ miles from Syracuse, N. Y., ½ mile from New York State Thruway exit and 1½ miles from Penn-Can Highway exit, 500 yards from New York Central R.R. freight line, on a site of approximately 12 acres.

MACHINERY, EQUIPMENT, FURNITURE, FIXTURES Modern machinery for boring, broaching, drilling, grinding, milling and turning. Extensive heat treating and shot-peening facilities. Equipped to carburize and harden, cyanide, martemper, austemper and nitride. Plating facilities to copper plate, cadmium plate, anodize, dichromate, parco lubrite and tin plate. Complete inspection facilities including magniflux and zyglow equipment. Office furniture, equipment and machines, drafting room furniture and equipment, etc.

Plant and machinery were in full operation until December 31, 1960, have been scrupulously maintained since then, and are ready for immediate full scale operation.

INVENTORIES Spare parts for current production engines, tool crib, maintenance supplies and equipment.

PRODUCT LINE Complete rights of the Company in and to the widely known "Franklin" brand name and production of FAA-certificated aircraft engines, including all special tooling, jigs and fixtures, etc. for their manufacture. Includes the highly successful Franklin "335" turbosupercharged engine currently used in Bell 47G-3 "Trooper" helicopters and in military installations, plus nearly completed engineering for fixed wing aircraft applications of same basic engine having excellent sales potential; other "335" series engines; also Franklin "425" military turbosupercharged helicopter engine readily adaptable for commercial production.

Offers will be entertained for all the above assets in bulk or for any of the four single units as above described.

The exact date, place and terms of the sale will be announced in the very near future.

Complete details concerning all assets will gladly be furnished to interested parties, including independent accountant's analysis of the fair value of the product lines. Arrangements for physical inspection and appraisal and for personal discussions may be made by writing to: **C. F. B. Roth, President, Aircooled Motors, Inc., Syracuse 8, N. Y.**

Airlines Report Officers' Remuneration

Washington—Following is a list of airline officers' salaries, bonuses and indirect compensation, expenses and stock holdings for the year ending Dec. 31, 1960, as filed with the Civil Aeronautics Board:

American Airlines—C. R. Smith, president and director, $85,000 salary, 25,000 shares of common stock; **Wm. J. Hogan**, executive vice president and director, $71,389 salary, 500 shares of common stock; **O. M. Mosier**, executive vice president and director, $70,000 salary, 3,000 shares of common stock; **G. A. Spater**, executive vice president and general counsel, $60,000 salary, 500 shares of common stock; **C. W. Jacob**, senior vice president and secretary, $65,000 salary, 4,000 shares of common stock; **G. M. Sadler**, vice president and general manager, $50,000 salary, no stock; **A. R. Bone Jr.**, vice president, $35,000 salary, 2,000 shares of common stock.

M. A. Brenner, vice president, $25,000 salary, 155 shares of common stock; **W. G. Conrad**, vice president (from Jan. 20, 1960) $19,868 salary, 200 shares of common stock; **G. E. Coon**, vice president, (from Jan. 20, 1960) $20,089 salary, 200 shares of common stock; **W. B. Davis**, vice president, (from Jan. 20, 1960) $28,750 salary, no stock; **R. L. Fitzpatrick**, vice president, $40,000 salary, no stock; **L. E. Glasgow**, vice president and controller, $42,500 salary, 600 shares of common stock, three shares held in the name of others.

R. A. Goebel, vice president, $27,500 salary, no stock; **G. P. Hitchings**, vice president, (from Apr. 16, 1960) $24,792 salary, no stock; **L. J. Hunt**, vice president, (from Jan. 20, 1960) $28,750 salary, no stock; **P. W. Kayser**, vice president, $45,000 salary, 400 shares of common stock; **M. D. Kochman**, vice president, $35,000 salary; no stock; **R. F. Lambert**, vice president, $19,894 salary, 300 shares of common stock, 25 shares held in the name of others; **J. J. Lamond**, vice president, (from Jan. 20, 1960) $20,089 salary, no stock; **W. C. Lawrence**, vice president, $27,894 salary, 680 shares of common stock; **Wm. Littlewood**, vice president, $35,000 salary, 1,880 shares of common stock; **W. H. Miller**, vice president, (from Jan. 20, 1960) $25,315 salary, 1,970 shares of common stock.

A. J. Moccia, vice president and assistant treasurer, $25,549 salary, no stock; **F. J. Mullins**, vice president, $30,000 salary, 400 shares of common stock; **C. N. Oursler**, vice president, $33,071 salary, 200 shares of common stock; **W. Player**, vice president, $40,000 salary, 800 shares of common stock; **G. W. Shiles**, vice president, (from Jan. 20, 1960) $18,063 salary, no stock; **N. L. Smith**, vice president, $30,000 salary, 10 shares of common stock; **C. R. Speers**, vice president, $40,000 salary, 3,200 shares of common stock; **C. H. Startup**, vice president, $30,000 salary, no stock; **D. D. Taylor**, vice president, $25,000, no stock.

E. C. Taylor, vice president, $35,000 salary, 200 shares of common stock; **W. B. Whitacre**, vice president, $38,097, no stock; **W. G. Whitney**, vice president, $25,000 salary, 410 shares of common stock; **F. C. Wiser**, vice president, $40,000 salary, 350 shares of common stock; **P. G. Larie**, treasurer, $24,000 salary, no stock; **M. G. Beard**, assistant vice president, $25,000 salary, 2,500 shares of common stock; **W. W. Braznell**, assistant vice president, $34,000 salary, no stock; **A. Di Pasquale**, assistant vice president, $25,000 salary, no stock; **W. H. Hall**, assistant vice president, (from July 20, 1960) $21,594 salary, no stock; **T. F. Holden**, assistant vice president, $20,000 salary, no stock; **J. D. Hungerford**, assistant vice president, $25,000 salary, 550 shares of common stock.

J. K. Kilcarr, assistant vice president and assistant treasurer, $20,978 salary, no stock; **F. W. Kolk**, assistant vice president, (from July 20, 1960) $22,679 salary, no stock; **V. J. Long**, assistant vice president, $23,000 salary, 200 shares of common stock; **M. L. Muse**, assistant vice president, (from Oct. 1, 1960) $5,625 salary, no stock; **D. F. O'Donoghue**, assistant vice president, $27,500 salary, no stock; **W. F. Prigge**, assistant vice president, $25,000 salary, 150 shares of common stock; **H. Don Reynolds**, assistant vice president, $25,000 salary, 100 shares of common stock. **M. Shipley**, assistant vice president, $24,000 salary, 400 shares of common stock; **A. E. Smick**, assistant vice president, $23,000 salary, 40 shares of common stock; **W. D. Stewart**, assistant vice president, (from May 5, 1960) $21,474 salary, no stock; **R. B. Wyland**, assistant vice president, $20,894 salary, no stock; **W. J. Corbett**, assistant controller, $20,000 salary, 100 shares of common stock in the name of others; **J. V. Dooley**, assistant controller, $23,000 salary, no stock; **J. T. Slavin**, assistant treasury and assistant secretary, $10,000 salary, no stock; **A. A. Paradis**, assistant secretary, $19,429 salary, no stock; **H. T. Ames**, director, no salary, 3,500 shares of common stock, 2,000 shares held in the name of others; **J. W. Aston**, director, no salary, 500 shares of common stock; **H. E. Benedict**, director, no salary, 2,000 shares of common stock; **J. Bruce**, director, no salary, 1,100 shares of common stock; **C. L. Burges**, director, no salary, 100 shares of common stock; **F. H. Burr**, director, no salary, 100 shares of common stock; **W. L. Canday**, director, no salary, 200 shares of common stock; **A. G. Carter Jr.**, director, no salary, 9,400 shares of common stock; **W. L. Cisler**, director, no salary, 200 shares of common stock; **T. M. Conroy**, director, no salary, 500 shares of common stock.

Ralph S. Euler, director, no salary, 2,700 shares of common stock; **M. Fleischmann**, director, no salary, 100 shares of common stock; **E. H. Herzog**, director, no salary, 1,000 shares of common stock; **J. A. Jackson**, director, no salary, 500 shares of common stock; **R. W. Miller**, director, no salary, 1,000 shares of common stock; **E. M. Queeny**, director, no salary, 13,000 shares of common stock.

Following firms were paid for services rendered during 1960: **Raymond E. Buck**, legal, $9,103; **Cleary, Gottlieb, Steen & Hamilton**, legal, $10,792; **Conner, Winters, Randolph & Ballaine**, legal $6,744; **Covington and Burling**, legal, $324,595; **Debevoise, Plimpton & McLean**, legal, $291,795; **O'Melveny & Myers**, legal, $11,105; **Overton, Lyman & Prince**, legal, $19,091; **Savage, Gibson, Benefield & Shelton**, legal, $8,910; **Willkie, Farr, Gallagher, Walton & Fitz Gibbon**, legal, $6,472; **Kahn & Jacobs**, architects, $83,453; **Naess & Murphy**, architects, $6,684; **Welton Becket & Associates**, architects and engineers, $28,966; **Coston, Frankfort & Short**, architects and engineers, $69,842.

A. B. Cassidy & Associates, management engineers, $36,443; **Walter Dorwin Teague Associates**, designers, $14,966; **Henry O. Golightly & Co., Inc.**, management consultants, $79,430; **Arthur D. Little**, industrial consultant, $76,029; **McKinsey & Co., Inc.**, management consultants, $110,539; **Paul B. Mulligan & Co., Inc.**, management consultants, $73,781; **Jessie J. Friedman & Associates**, public relations, $11,828; **Opinion Research Corp.**, marketing research, $73,775.

United Research, Inc., market research, $5,510; **Powell, Schoenbrod & Hall**, promotional service, $12,000; **Margaret P. Thale**, public relations, $9,114; **E. L. Howe**, public relations, $11,236; **Boyden Associates, Inc.**, personnel services, $8,613; **Hoff, Canny, Bowen & Associates**, personnel services, $9,555; **Charles Cramer, M.D.**, medical, $6,180; **Lovelace Foundation**, medical research, $6,028; **Kielty Dechart & Hamp, Inc.**, personnel training, $63,917; **Dickie-Raymond, Inc.**, sales promotion, $19,983; **Arthur Young & Co.**, public accountants, $61,375; **Morgan Trust Co.**, trustee for pension trust, $32,897.

American did not list bonus and indirect compensation or expenses borne by the carrier in this report. They will be filed separately.

Braniff Airways, Inc.—C. E. Beard, president and director, $72,000 salary, 21,600 shares of common stock, $5,248 expenses; **J. W. Miller**, executive vice president, $47,500 salary, 1,206 shares of common stock, $2,285 expenses; **R. Brack**, senior vice president, $33,750 salary, 300 shares of common stock, $3,948 expenses; **R. V. Carleton**, senior vice president and director, $39,300 salary, 4,000 shares of common stock, $2,450 expenses; **C. G. Adams**, vice president, secretary and director, $33,000 salary, 6,759 shares of common stock, $721 expenses; **F. J. Beisecker**, vice president-financial services, $16,650 salary, no stock, $300 expenses.

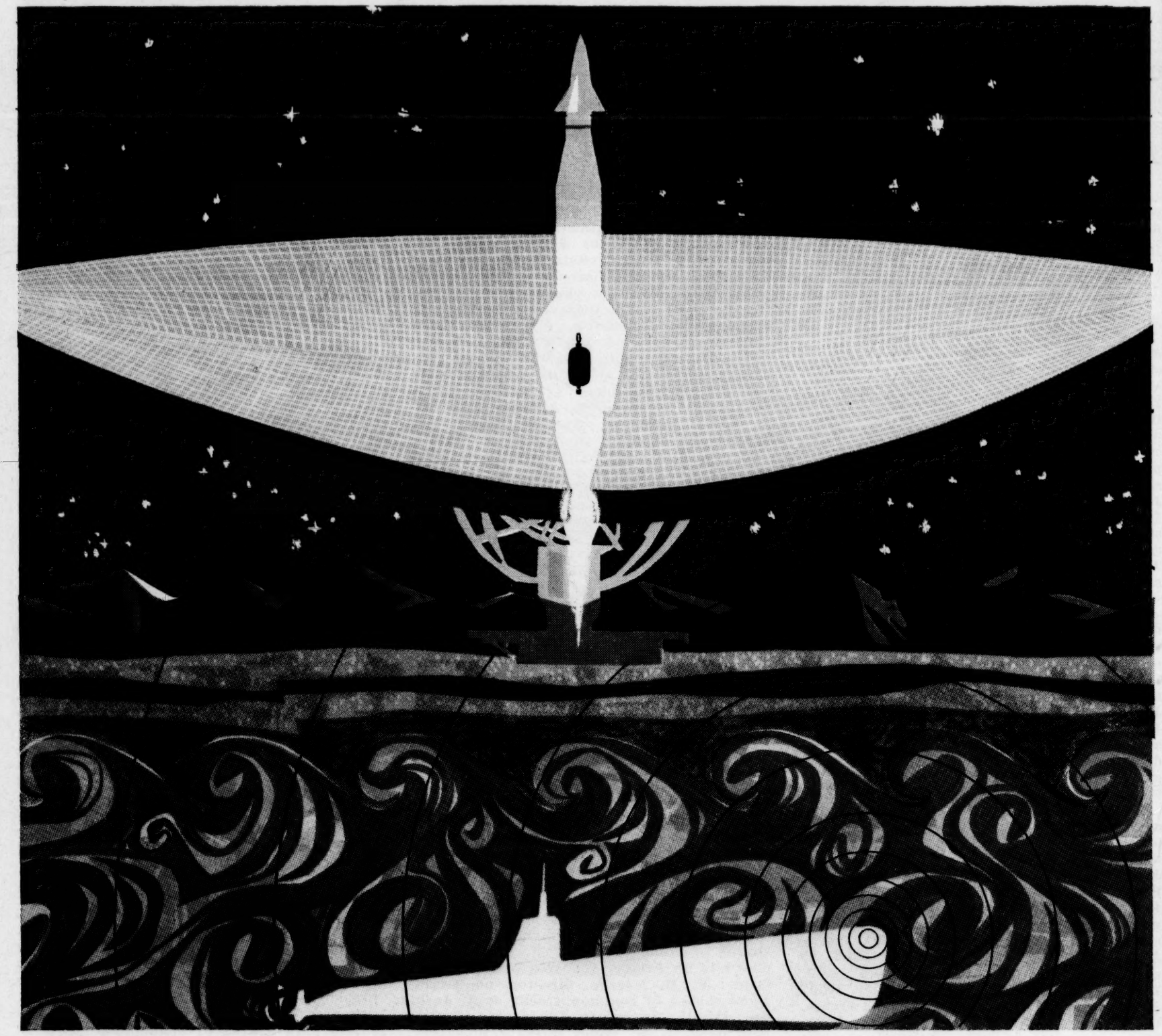
H. Bolding, vice president-purchasing and stores, $19,500 salary, four shares of common stock, $434 expenses; **R. H. Burck**, vice president-traffic and sales, $15,900 salary, 100 shares of common stock, $3,570 expenses; **M. Harrison**, vice president-industrial relations, $24,900 salary, no stock, $866 expenses; **W. Henshel**, vice president-public relations, $22,900 salary, no stock, $2,248 expenses; **J. R. Horton**, vice president-maintenance and engineering, $18,900 salary, no stock, $565 expenses.

D. Hughes, vice president-operations, $29,880 salary, no stock, $774 expenses; **T. Robertson**, vice president-economic planning, $13,500 salary, no stock, $1,197 expenses; **R. C. Schrader**, vice president and director, $18,000 salary, 1,200 shares of common stock, no expenses; **C. R. South**, vice president, $23,000 salary, no stock, $6,571 expenses; **O. Crane**, treasurer, $15,900 salary, 213 shares of common stock, $628 expenses; **R. L. Barrier**, assistant vice president-budgets $13,500 salary, no stock, no expenses; **R. Frost**, assistant vice president-properties, $10,725 salary, no stock, $1,789 expenses.

V. A. Kropff, assistant vice president-executive projects, $13,800 salary, $1,525 expenses; **J. Seay**, assistant vice president-ground operations, $12,990 salary, 242 shares of common stock, $670 expenses; **J. Sorlie**, assistant vice president-flight dispatch, $13,800 salary, no stock, $38 expenses; **L. Eden**, assistant treasurer, $13,050 salary, no stock, $274 expenses; **Velta Bowlware**, assistant secretary, $5,700 salary, 40 shares of common stock, no expenses.

F. Jones, director, no salary, 2,132 shares of common stock, $400 expenses; **W. Blakley**, director, no salary, 522,955 shares of common stock, $400 expenses; **G. A. Butler**, director, no salary, 10,720 shares of common stock, $400 expenses; **F. Flenniken**, director, no salary, 339 shares of common stock, $400 expenses; **T. N. Law**, director, no salary, 130 shares of common stock, $200 expenses; **M. McGreevy**, director, no salary, 3,000 shares of common stock, $400 expenses; **A. Shivers**, director, no salary, 700 shares of common stock, $400 expenses; **J. Walker**, director, no salary, 2,100 shares of common stock, $400 expenses; **R. Whiteford**, director, 1,120 shares of common stock, $200 expenses.

Following firms were paid for services rendered during 1960: **Whiteford, Hart, Carmody and Wilson**, legal, $76,207, **Ernst & Ernst**, audit, $11,964.



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Jet Advent Stresses Ground Handling Lag

By Barry Tully

New York—Major airlines, drawing on over two years jet experience, are striving to refine ground handling operations in order to complement in-flight speed increases without increasing costs.

Both domestic and international carriers at New York International Airport, many of which now operate from new terminals, are concentrating their efforts to improve jet on-time departure percentages and to reduce such customer-frustrating items as lost baggage. The new terminals, with their greatly increased ramp space, serve to aid ground handlers in this respect, although several carriers are already planning gate expansion.

Carriers say that only about 2% of departures are late due to poor performance on the part of ground handling crews and equipment. The overall late percentage is much higher than this and varies considerably from month to month and airline to airline.

Primary cause is maintenance breakdowns of which a leading offender is hydraulic leaks. Another factor at Idlewild is that of jets being held at the gate by ground control due to traffic jams at the takeoff runway.

Despite good intentions and a generally efficient operation, there is considerable room for improvement. Current systems, while satisfactory during normal scheduled operations, break down when several incoming flights arrive simultaneously.

La Guardia Repairs

Repairs to La Guardia Airport are creating excellent examples of this shortcoming. A sudden wind shift or increase can produce a crosswind gradient at La Guardia sufficient to cause all arriving propeller traffic to be diverted to Idlewild. This creates peak traffic loads which severely tax the facilities of the domestic airlines at Idlewild, resulting in delays to the traveling public. Instrument flight conditions also can cause several jet transports to descend on a terminal simultaneously.

The fastest scheduled turnaround time for jet aircraft at Idlewild is about 1 hr. Most jet operators can report actual times which cut this almost in half, however, this record time usually results when an inspired crew attacks a clean (lightly loaded) aircraft. Fast turnarounds are significant in terms of aircraft utilization, however, from the passenger viewpoint, the important thing is the carrier's ability to adhere to the published schedule.

Another problem which appears a long way from solution is the chaotic charge of service vehicles which approach the arriving jet from all points of the compass. This waste of men and ground equipment is particularly apparent during periods of peak traffic loads.

One answer to this is more extensive use of hydrant facilities. In this respect Idlewild lags behind other world airports. The Port of New York Authority reports that negotiations with the airlines are incomplete and no schedule is set for its proposed pipeline fuel delivery system.

Some terminals have hydrant fuel system plumbing installed, others await the availablity of the fuel.

Ramp Pits

United, American and PanAm employ pits at ramps to supply electrical power to jet transports. This serves to reduce some traffic as does the baggage conveyor system. A hydrant air conditioning system in operation at Ft. Worth's Amon Carter Airport eliminates another service vehicle.

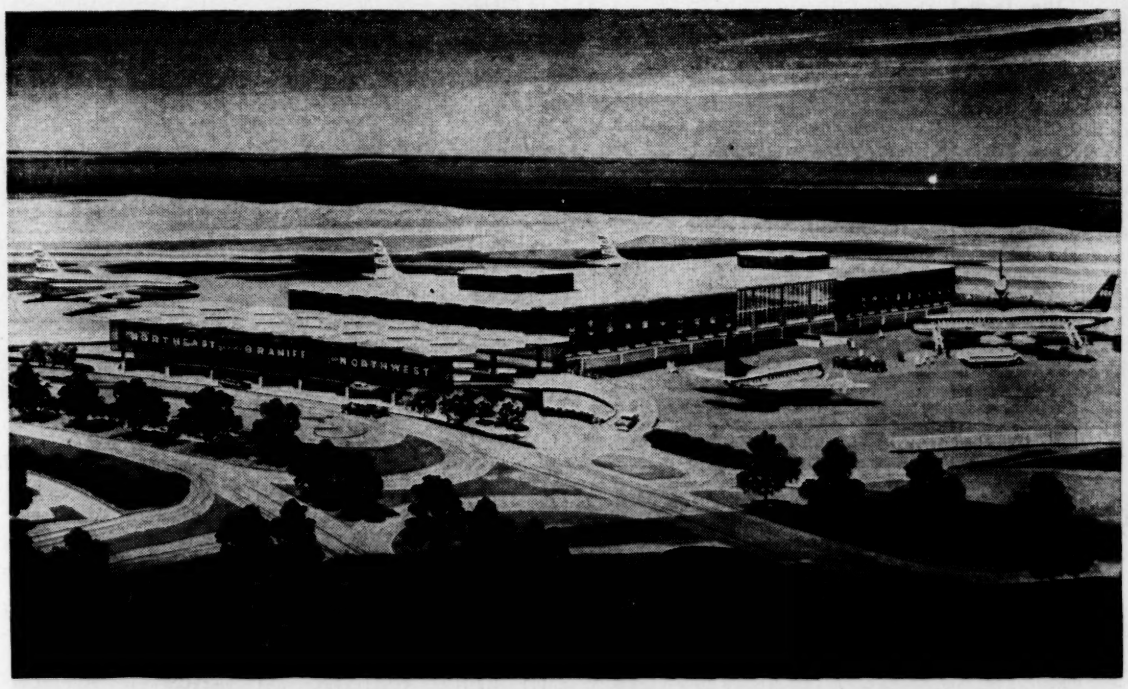
The cost of installing many of these systems at vast, decentralized Idlewild (with its high water table) is staggering, and leads to the suspicion that the profit-squeezed airlines will endure the confusion and consider more pragmatic means to increase ground handling efficiency.

Walkways, providing direct access from loading gates to the aircraft, are gaining favor throughout the nations' jet airports. These Jetways eliminate the need for passenger ramps and provide protection for passengers from precipitation, cold and high winds.

Fueling the jets is usually accomplished by two fuel trucks which can complete the job in less than 20 min. Experience has produced close coordination between fuel supplier and the carriers and the fuel usually is available on time.

The most time-consuming chore on handling a jet turnaround is cleaning the passenger compartment—averaging about seven man hours. Interior aircraft design plays an important part here. Factors such as easily cleaned ash receivers can facilitate the performance of a cleaning crew. The use of Velcro nylon fastener tape speeds replacing soiled head covers on seats and more-easily-cleaned nylon rugs are helpful.

The various methods of handling passenger baggage at different terminals tends to emphasize carrier individuality. Container systems, conveyors and conventional propeller aircraft treatment appear to compete fairly evenly. Eastern, one of the larger carriers still loading jets by hand from baggage



Multi-Carrier Idlewild Terminal Planned

New terminal being built at Idlewild International Airport, New York, for Northeast Airlines, Northwest Orient Airlines and Braniff International Airways is scheduled for early 1962 completion. Terminal will cost an estimated $10 million; passengers will enter and leave the structure through open air entrances protected by concrete canopies.

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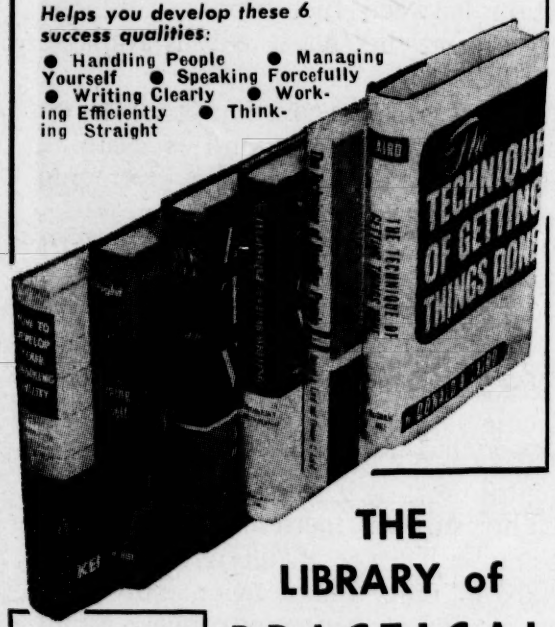

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trains, contends that it matches more sophisticated systems in speed and efficiency.

United says that the advantage of its conveyor system is in its ability to grow and to handle peak loads with fewer men. One persistent problem at Idlewild is the high percentage of baggage that goes astray while the passenger is changing airlines. This is particularly prevalent on international flights and the working level solution is "blame the other guy."

As jet aircraft service expands to smaller airports, the carriers hope to minimize ground support equipment expense. Most carriers admit to grossly underestimating the high cost of jet support equipment. Explanations for this range from application of military handling techniques and super salesmanship on the part of the jet manufacturers to inherent optimism natural to the business.

High Costs Seen

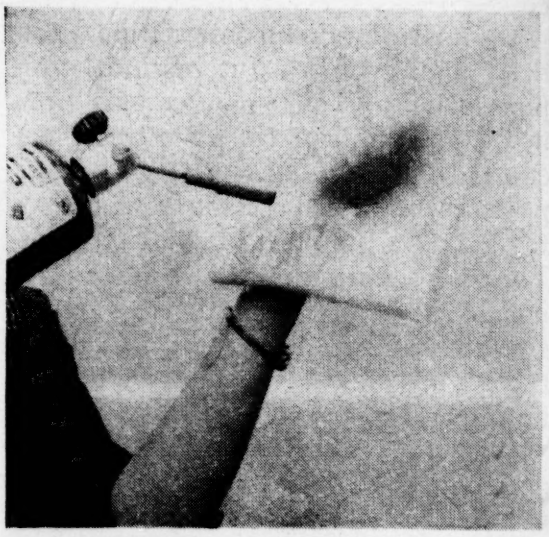
Cost of installing expensive starting turbines, generators and air conditioning equipment at smaller airports will be high, but this time the accounting departments will not be unprepared. Follow-on orders for ground handling equipment are being let only after a hard look at equipment reliability and over-all operational costs.

Pooling of ground equipment, which is growing among foreign carriers, runs counter to the competitive nature of most domestic airlines. Arguments against pooling ground equipment include: Loss of "image," dislike for the competition, and differences in opinions as to how to perform the same job. The feeling appears to be that lending equipment in an emergency is fine, but sharing costs and use of equipment is not.

One approach to increasing efficiency and reducing ground handling costs at intermediate jet stops is to design the aircraft to be more independent of ground equipment. The Boeing 727, which will be purchased by United and Eastern, includes integral passenger stairs and utilizes a starter/generator necessitating only electrical power for engine starting. Carry-on baggage facilities serve to reduce baggage handling and are popular with able-bodied passengers.

The airline's appear to be responding to criticism in regard to providing passengers with accurate estimates of departure delays. Ground personnel at the more progressive carriers are urged to make realistic estimates of revised departure time and to forecast quick reappraisals when the first estimate proves optimistic. Most airlines experienced poor on-time departures with jets until handling and maintenance techniques were refined and persistent "bugs" in the jets were reduced.

Now, with shorter flights magnifying departure delays and jet competition everywhere, the practice of stringing the passenger along creates considerable ill feeling. Precisely how much of this shiny idealism deteriorates when it comes to turning customers over to the competition is difficult to estimate. Most station personnel agree, in principle, however, that the honest approach is in the best interest of an industry which is striving to broaden its markets.



THERMOSORB sample, less than ½-in. thick, protected model's hand for several minutes from even becoming warm despite direct application of 2,200F flame.

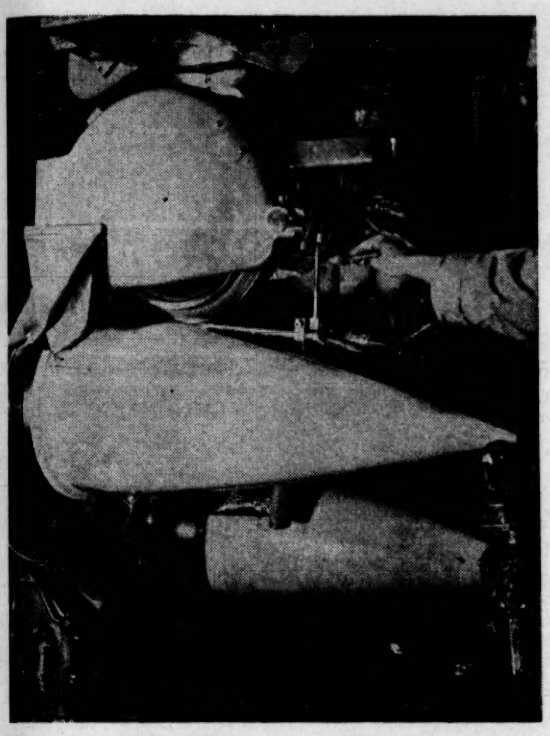
Blankets of Water Protect From Heat

Dallas, Tex.—A coolant blanket, composed of more than 90% water yet having the handling characteristics of a solid, has been developed for aerospace vehicle applications by Astronautics Division of Chance Vought Corp. here.

Placed within the inner and outer walls of a space vehicle, the material—called Thermosorb—is capable of maintaining inside temperatures well within human tolerance limits although outside skin temperatures may reach 4,000F. The material provides lighter weight and a higher degree of reliability than more complex cooling systems, accord to J. R. Clark, division vice president.

In initial applications, to protect instrumentation and control system components in compartments adjacent to rocket motor nozzles, Thermosorb maintained temperature of less than 150F on its cool side while temperatures on the nozzle outer wall attained 2,200F.

Indications are that the material is also useful in providing additional payload space that cannot be used ordinarily due to high temperatures occasioned by motor exhaust temperatures or high re-entry speeds, simply by insu-



Ceramic Tartar Radomes

Ceramic radomes for the Navy Tartar surface-to-air missile are ground to specification on a production basis at Corning Glass Works, Corning, N. Y. The Pyroceram radomes are in follow-on production under contract from Convair (Pomona) Division of General Dynamics, Tartar prime contractor.

lating these areas with Thermosorb. In addition to these more exotic applications, Chance Vought believes that the material will be useful in fire prevention walls, protective clothing used in fire fighting, shipping containers for delicate instruments and in transport vehicles for fire prevention.

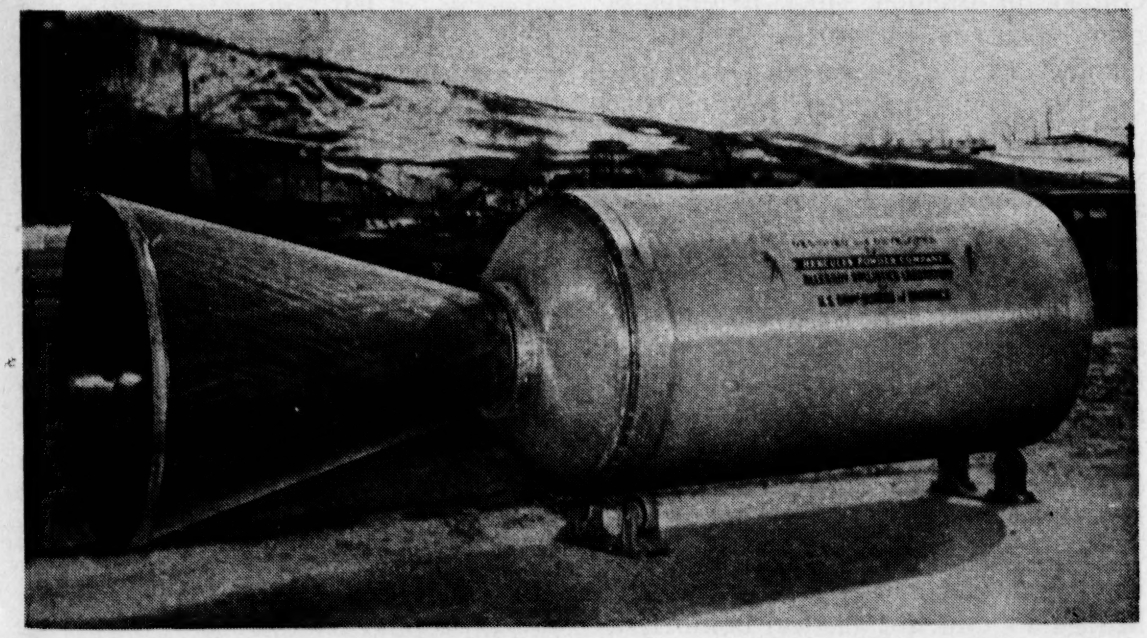
Makeup of the material is such that can be produced at a price making it feasible for commercial applications and it does not require any unusually special machinery to make.

Thermosorb retains water with such tenacity that specimens have been subjected to 16g forces in a centrifuge without the water separating. The material has satisfactorily undergone vibration testing at 20 to 2,000 cps. and has been subjected to high noise levels and to extreme temperatures.

In a demonstration, a section less than one-half inch thick has been held in hand and subjected to temperatures up to 4,000F from acetylene torches for several minutes without the hand getting uncomfortably warm. A test specimen subjected to an alcohol flame for 20 min. lost approximately an eighth of an inch of Thermosorb.

The material can be contoured in any desired shape or thickness to fit custom installations, the pads being installed through access panels which also serve as inspection plates. The material is capable of retaining its insulating qualities for several years in the static state, Vought engineers say, without need for auxiliary equipment, pumps or other failure-prone items to support it.

Compared with other water coolant systems, such as water wicking, which has a percentage of some 85% water in the tube-encased material, Thermosorb can provide savings of more than 25% in weight.



THOMPSON RAMO WOOLDRIDGE nozzle exit cone is installed on Allegany Ballistics Laboratory X254 Antares solid propellant rocket motor assembly.

Plastic Cone Liners Developed by Tapco

Tapco Group of Thompson Ramo Wooldridge, Inc., has developed a new method of manufacturing reinforced plastic expansion cone liners for Scout third-stage nozzles. The process involves standard manufacturing equipment to produce "efficient, high performance nozzle expansion cone liners for solid propellant rocket motors."

The reinforced plastic component is integrated into the nozzle assembly by the Allegany Ballistics Laboratory.

The nozzle liner has been used successfully in six third-stage Scout launchings and also is being employed in the Air Force Blue Scout program.

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Time to 32,000 ft.	6 min.
Mean endurance	45 min.
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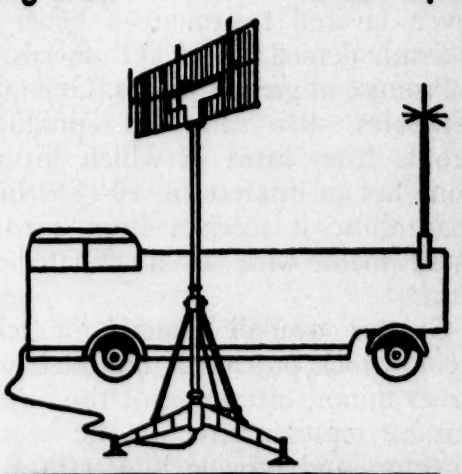
Take-off weight	1,470 lbs.
Span	11.15 ft.
Length	17.71 ft.
Diameter of fuselage	2.16 ft.
Wing area	34.34 sq. ft.



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Aerospace Investment Abroad: Part II

Industry Ties Held Key to European Sales

By Cecil Brownlow

Geneva—What does the next production round in West Europe hold in store for the U.S. aviation industry?

Many industry officials and representatives believe the profit potential from straight, no-strings-attached license agreements already has reached its zenith (AW Apr. 24, p. 54) and that, to survive and compete in the market of the future, steps must be taken now to gird for the next, post-Lockheed F-104 era by purchase of stock holdings in established firms, creation of new, jointly-owned companies with European partners or establishment of outright subsidiaries. Motives behind such reasoning include:

• **Fear of being frozen out.** European governments and industry are becoming more anxious to produce their own products as the level of post-World War II technology increases. United States representatives of companies that lack strong ties in the countries where they are dealing already complain that government officials have become reluctant to discuss future weapon system plans with them while remaining relatively conversant with industries physically located in the nation concerned. "It looks as though we may have to buy in if we're going to compete. Right now, we can't get them to talk to us," an industry representative said recently in commenting on the market situation in one European nation.

• **Belief in some quarters** that European entries in North Atlantic Treaty Organization hardware competitions are given favored treatment—a belief that is firmly denied by NATO officials.

• **Promise of greater profits.** One official estimates that licensed production profits from firms in which his company has an interest are 10-15% higher than those it receives from an agreement made with an unaffiliated concern.

• **Greater over-all control,** a related item. Stock purchases, although sometimes minor, often permit the buyer to put his representative on the board of directors and provide him with a day-to-day voice in production, marketing and sales practices. Joint companies accomplish the same goal.

• **Extension of domestic** diversification practices. European interests help broaden a firm's financial base and ease its dependence upon U.S. defense contracts.

• **Avoidance of protective tariff** walls that are being increasingly raised by some countries as the European economic community gains in stature. Tariffs plus increased cost of U. S. production also can make it impossible for a U. S. firm to approach the price of a foreign competitor on a similar item.

• **Acquisition of European** technical know-how, inventions and developments for possible production and/or marketing in the U. S. and elsewhere.

Once the decision has been made to enter the European market with both feet, the remaining—and major—question is how—and at the least peril with the promise of greatest profit. The routes taken thus far have been varied but generally fall within the stock purchase, joint company or subsidiary category.

Stock Purchases

Stock purchases have been on the rise over the past two years, notably by United Aircraft Corp. Present United holdings include:

• **Germany's Weser Flugzeugbau GmbH.** of Bremen, stock holdings of over 40% of the total. Weser, a member of the Lockheed F-104 production consortium, is building two prototypes of the turbine-powered version of the Sikorsky S-64 Flying Crane and expects substantial follow-on production orders from the West German government for army, navy and air force use and possibly from France as well. Weser also holds the license for European production of the S-61D transport helicopter in Europe.

• **France's Societe Nationale** d'Etude & de Construction de Moteurs d'Aviation (Snecma), stock holdings of 10.9% of the total. Snecma, the engine firm now producing the Atar O9B for the Mirage IV Mach 2 tactical bomber, is scheduled to build Pratt & Whitney's 8,250-lb.-thrust JTF10-A turbofan engine for an advanced version of the Sud Caravelle, the Mk.X, if and when the new model of the jet transport is ordered into production.

• **Italy's Microtecnica S.p.A.,** stock holdings of approximately 50% of the total. Microtecnica, a manufacturer of electromechanical products, is adapting a version of the Norden-stabilized platform for Italian navy use.

• **France's Societe Precilec,** an electronics firm, stock holdings of 20% of the total plus an equal interest in Societe Somalec, an engineering firm affiliated with Precilec. The French company holds exclusive licensed production rights of Norden products for the European Common Market area.

• **France's Ratier-Figeac,** stock holdings of 15% of the total. A long-time licensee, the firm will continue to produce Hamilton Standard products under license for the Common Market countries.

Other stock purchases include Republic Aviation's one-third interest in Fokker, which is incorporating the American firm's research experience into its entry in the NATO competition for a V/STOL close-support fighter; Lockheed Aircraft Corp.'s substantial holding in Italy's Aeronautica Macchi, which is producing the LASA 60 utility aircraft and spare parts for the T-33 trainer under license, and Cessna's 49% interest in France's Max Holste (Societe Anonyme Nouvelle des Avions). Cessna, in a reverse twist, is considering licensed production in the U. S. of the MH 260 Super Broussard light transport.

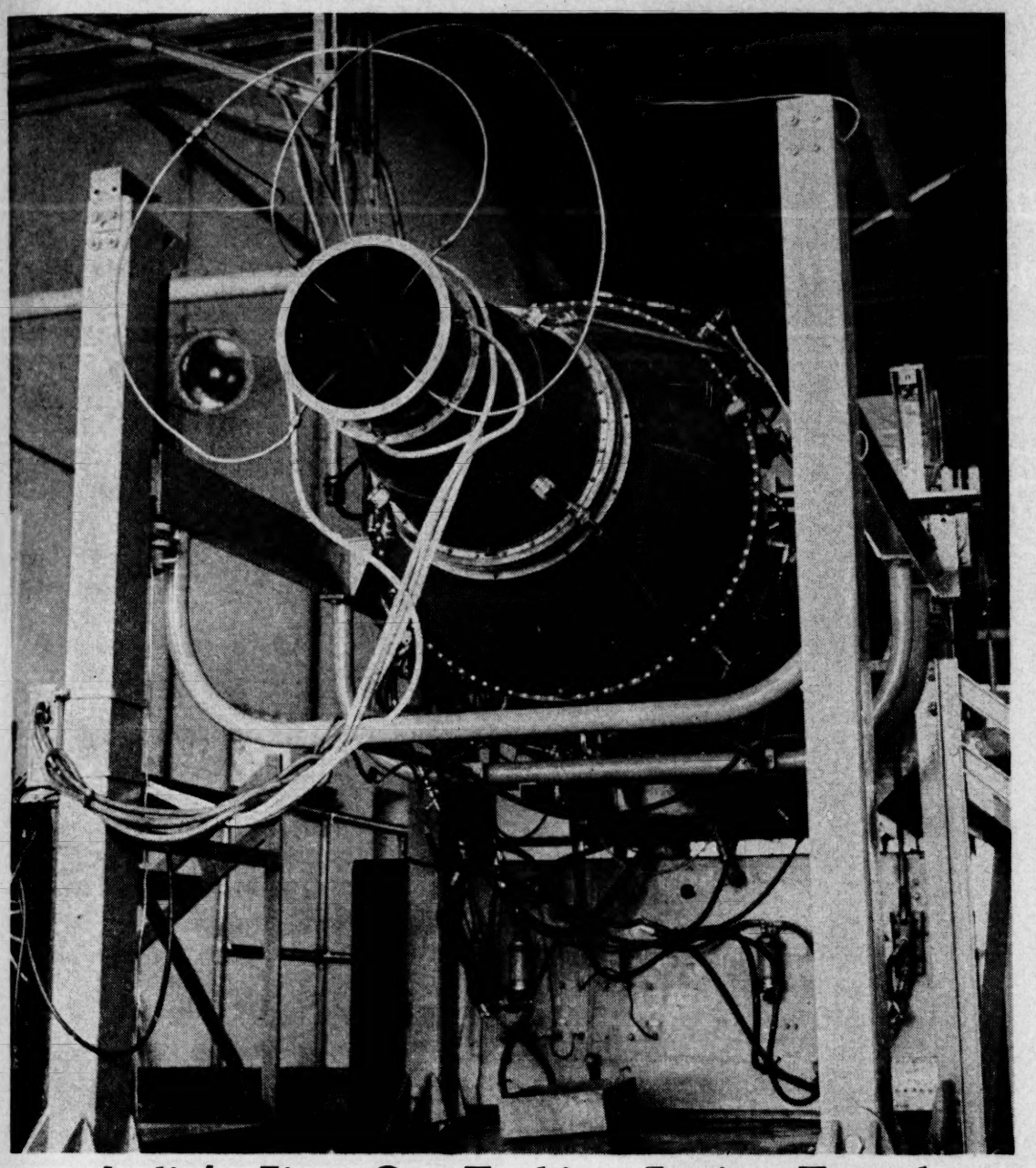
Joint Firms

Companies that have preferred to take the joint firm route in partnership with existing European companies include North American Aviation, Inc., and Hughes Aircraft Co.

In Germany, North American and Demag-zug GmbH., an electronics and machine tool manufacturer, have joined in the establishment of a new firm, Interatom, near Cologne. In France, it became a partner of Societe Alsacienne de Constructions Mecaniques (SACM) and Chantier Atlantiques in the formation of Dynatom located in Paris. As their names imply, both joint firms are in the nuclear energy field concentrating upon power and maritime applications.

A Hughes subsidiary, HUSINT S. A. with headquarters in Geneva, and Belgium's Societe Anonyme Belge de Constructions Aeronautiques (Sabca) have jointly formed Compagnie Belge d'Electronique et d'Automation (Cobelda) for electronics manufacturing in Europe.

United States companies preferring the more-traditional path of establishing fully-controlled subsidiaries include Perkin-Elmer Corp., with two Euro-



India's First Gas Turbine Engine Tested

Designed and built by Indian Air Force technicians, India's first gas turbine jet engine, with a thrust rating of 2,200 lb., successfully completed trial tests. Engine, according to designers, has cannular combustion chamber incorporated in centrifugal gas turbine.

pean manufacturing companies—Germany's Bodenseewerk Perkin-Elmer & Co., prime contractor for the multination Sidewinder air-to-air missile production program in Europe, and England's Perkin-Elmer, Ltd.—plus sales-service subsidiaries in six countries.

Lear, Inc., has its German subsidiary, Lear GmbH., as does Kollsman Instrument Corp., with Kollsman Luftahrt Instrumente; Collins Radio Co., with Collins Radio GmbH., and International Telephone and Telegraph Corp., with Standard Elektrik Lorenz. Another ITT subsidiary, Standard Electria, of Portugal, is also a licensee in the European Sidewinder production program.

Almost all of these firms also have straight license pacts with unaffiliated European companies. North American, for example, has agreements with several manufacturers for licensed production of its NASARR fire control system for the European F-104 program, a fact largely dictated by Lockheed's sale of the weapon system as a package production item in several nations, and a technical aid agreement with the French rocket concern Sepr.

Lear, Inc., has issued licenses for production to firms in England and France and, in turn, has the right to manufacture small blower units developed by the British firm Louis Newmark in the U. S. Divisions of United Aircraft have negotiated straight license agreements in England, Italy and The Netherlands.

Time and circumstance are the dictator. Joint firms, for example, are established primarily when there is no immediate contract in the offing for a given product. In theory, however, most companies have their favored way when time permits a free hand.

Joint Firm Advocate

An advocate of joint firms said in support of his principle as opposed to straight license deals and stock purchases:

"A lot of people have liked licensing in the past. Here, you sell a company your brains, your lawyers set a reasonable fee and you're through with it, assuming the licensee gives you a fairly accurate account of what he's made.

"If you buy into a company, then you've got responsibilities. What's he doing? Where's he going? What's his profit potential, and is he making the most of it?

"Something else to consider is why is a company letting you buy into it? If you buy a sick company, you're taking a chance that it may fold no matter what your contribution, and, any way it goes, it's going to cost you a lot of money.

"If you buy into a healthy company, it's going to cost you premium prices. You also have to be careful in considering why a healthy company wants you to buy in.

"We think the answer is a joint company. Here, two or more firms—you and a local company—establish a new concern.

"You must hang a sign over the door, and you're in business. Then, you sit back and see how things go. If it looks good, then you can spend some money and begin to earn some money. It not, you haven't lost much."

The ideal, he said, is to find a situation "where you contribute only your technical skills, and the local firm puts up the needed capital. But, even if you have to put up some money, it doesn't compare with what it costs to buy a large share of an existing firm.

"An other advantage is that you have a say in the management of the firm from the start—including selection of officers and policy. But, over-all, the best thing is that you get some percentage of any profits and generally more [on a percentage basis] than you would get by buying into a firm."

He agreed with the stock purchase school, however, that "there might be times when it's better to buy into a company—one that's in a politically favorable position, for instance."

As to straight license agreements, his firm "shies away whenever possible. . . . What you are doing is building up a firm that can be damned tough competition in the next go-round." He said in summary:

"There will always be marginal companies over here who will be eager for U. S. licenses, technical know-how and money. . . . In the next five years or so, most of the firms will be building their own products or acting as part of a joint European effort building European products. . . . We'll stick it out with the joint companies."

Supporters of buying a permanent seat on the European market through stock purchases counter that, while a joint firm is getting organized, profits from an established affiliate can be rolling in.

The affiliate presumably already is well established, knows the market and its potential, has facilities and technicians ready to produce and, impor-

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tantly, is in the good grace of the most important customer—the government. It also permits the affiliate to retain its national identity.

"As a policy, we don't like to buy a majority holding," one spokesman said. "We want enough so that we can place our man on the board and have a say in the management, but we don't want to destroy the feeling that the company is a national firm, a name we're hiding behind. That's their biggest advantage –they can get into places where no American firms can go."

Another admitted that such investments are "calculated risks. There are a lot of 'if's' in any of these deals, but we think we have to expand to keep ahead of the game, and this is the way we think we should do it."

The "calculated risk," he added "can often be small in terms of dollars and cents. Sometimes there's not much more involved than an exchange of IOUs."

The straight-line connection with the United States has its advantages and disadvantages, according to an official whose company has leaned toward the establishment of subsidiaries.

"Sometimes it can work for you, it gives the customer a feeling of reliability in the product. However, in dealing with the governments, it can work against you. If we go in with a product and a German firm goes in with one that's almost as good, he's going to get the contract."

In this particular case, the U.S. firm has given serious thought to uniting its subsidiary with an established German company, if it can find one that meets its requirements and is willing, in hopes of offsetting this discrimination which it says it sometimes encounters.

Initial capital outlays for a manufacturing subsidiary are relatively large, but, when the profits begin to accrue, there is no splitting to be done. A subsidiary also, of course, permits absolute control.

U. S. Techniques

United States production techniques, management and sales approaches can be introduced with a minimum of difficulty. Production rates and distribution can be carefully geared to keep pace with the demands of the market. New products can be introduced or withdrawn with a minimum of red tape. The same applies to products developed by the subsidiary that the parent firm wants to produce and market in the U. S. or elsewhere.

The subsidiary also can—and sometimes does—become a licensee for production made by a domestic competitor of the parent company.

As U. S. firms move in various ways to ensure their future in the European market, the rising technology of Europe is making itself increasingly felt in the U. S.

Business and lightplane competition from Europe threatens to present a major challenge to traditional U. S. markets, particularly in the light jet executive field. Transport designs and powerplants already have made their impact. And, in efforts to diversify, close a competitive gap or simply buy a compoent idea, U. S. firms are manufacturing a number of European products under license ranging in size from gyros to complete aircraft systems.

Present agreements include the following:

- **France's Turbomeca,** license rights to Continental Aviation & Engineering Corp. for the manufacturer of small gas turbines.
- **Holland's Fokker,** production and marketing rights to Fairchild Engine & Airplane Corp. for the F.27 turboprop transport. Fairchild has built more than 80 of the aircraft thus far, according to Fokker.
- **France's Nord Aviation,** production rights to Bell Aerosystems Co. for the CT.41 and CT.20 target drone systems.
- **France's Sud Aviation,** production and marketing rights to Douglas Air-

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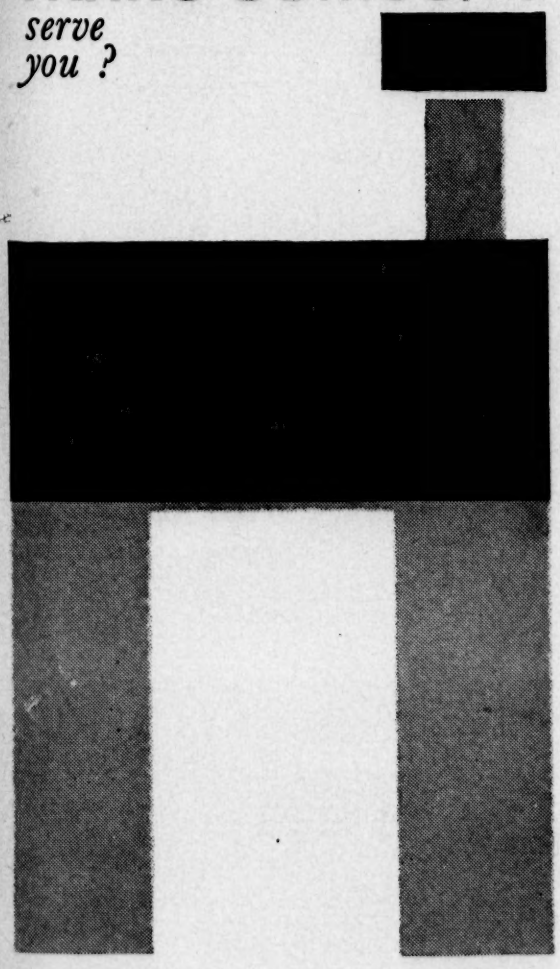

PROBLEMATICAL RECREATIONS 64

For $X < 1$ evaluate the infinite product: $(1 + X + X^2 + \ldots + X^9)$ $(1 + X^{10} + X^{20} + X^{30} + \ldots + X^{90})$ $(1 + X^{100} + X^{200} + \ldots + X^{900})$ $(\ldots$

– Mathematics Magazine

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ANSWER TO LAST WEEK'S PROBLEM: A observes that B and C are marked. A reasons that if he also is marked, B and C will each see two marked foreheads and all hands will stay raised. If, however, A is unmarked, B and C will each see one marked and one unmarked forehead. B's hand will be raised only because he sees a mark on C, and vice versa. Very shortly either B or C will recognize this state of affairs, deduce that he is marked, and put down his hand. A allows enough time for B or C to come to this conclusion, and since neither does, A knows that he also must be marked.

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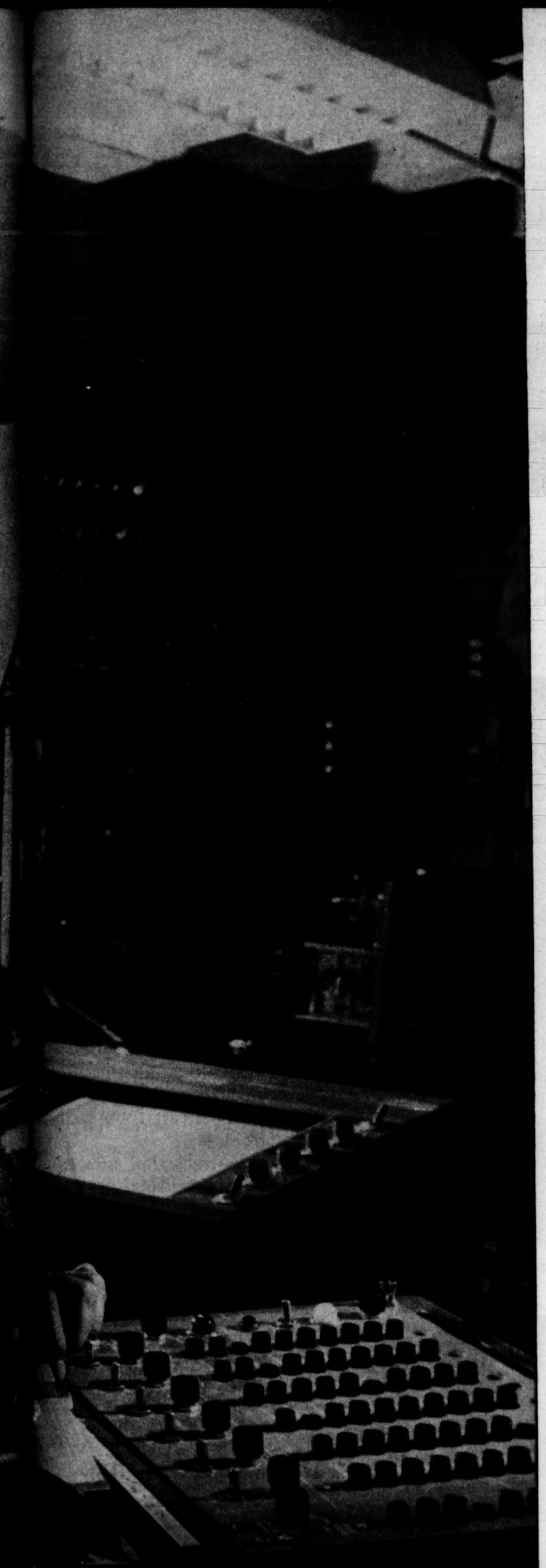

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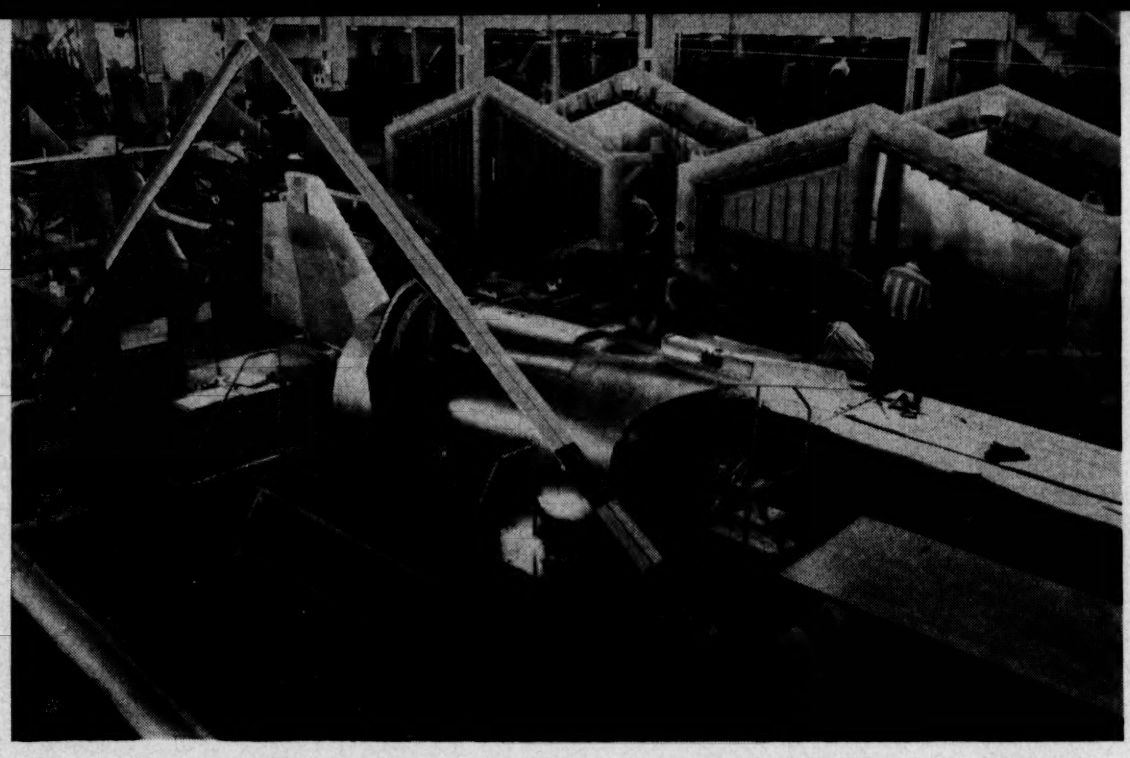
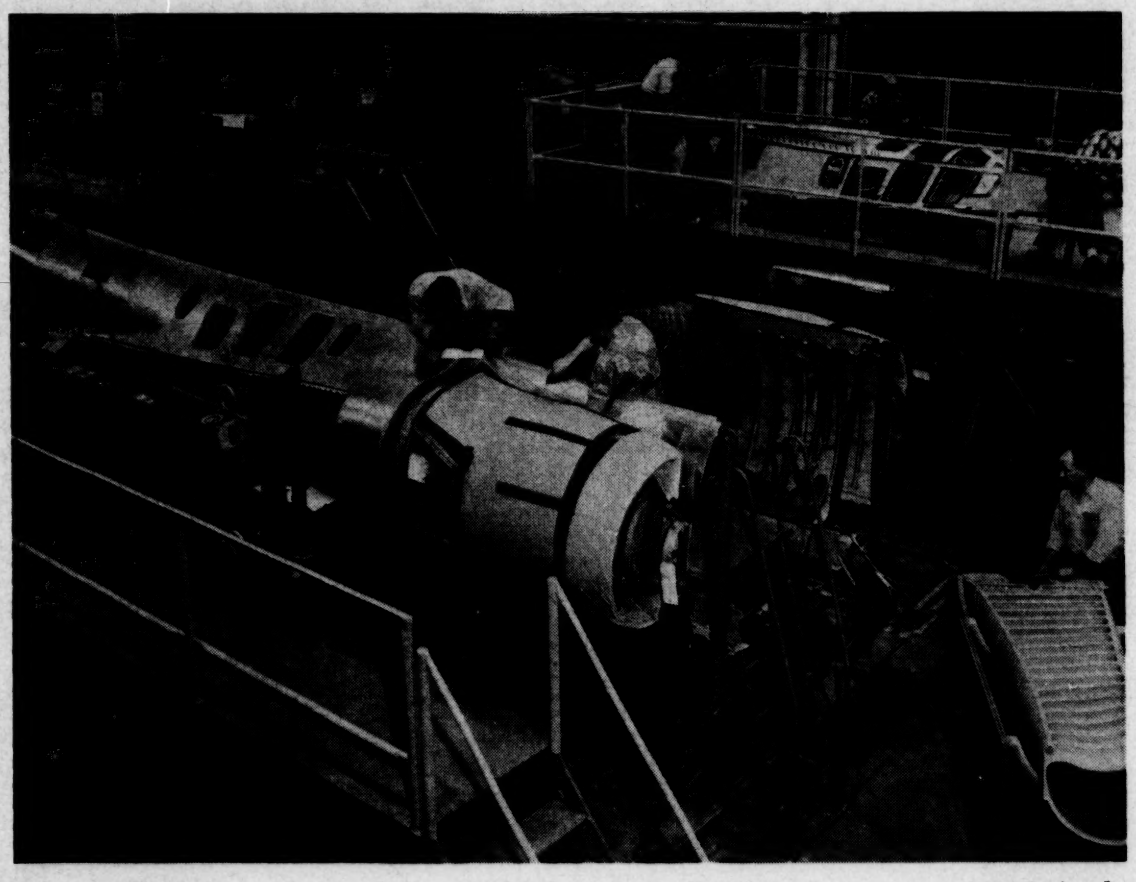
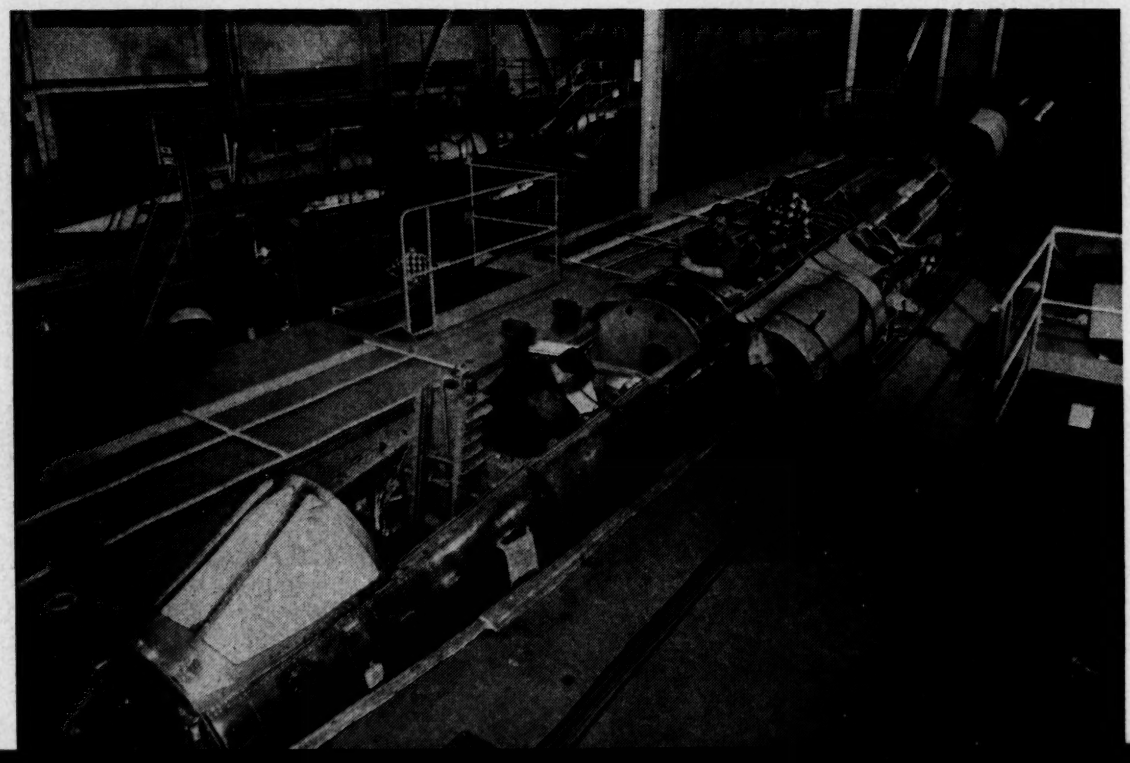


Canadair Produces CF-104s

Canadair, Ltd., subsidiary of General Dynamics Corp., is producing 200 CF-104 strike-reconnaissance aircraft at its Montreal plant for No. 1 Air Division of Royal Canadian Air Force (AW Apr. 3, p. 31). Aft fuselage section is in center above; vertical stabilizer and complete tail unit are at left. Horizontal stabilizers are in background. Four assembly jigs for horizontal stabilizers are at upper right.



Pair of mid-fuselage side panels is assembled (center). Panels incorporate engine air intake ducts (right foreground). Nearly-completed airframes are below.



craft Co. for the Caravelle medium-range jet transport.

- **Sud,** production and marketing rights to Republic Aviation Corp. for the Alouette and Djinn helicopters.
- **France's Morane-Saulnier,** production and marketing rights to Beech Aircraft Corp. for the MS-760 executive jet aircraft.
- **Britain's Short Brothers & Harland,** Ltd., production rights to Giannini Controls Corp. for pyrotechnic gyro systems for small tactical missiles.

In addition, the U.S. government holds production rights for the Nord SS-10 and SS-11 anti-tank missile systems, whose development was partially financed through U. S. mutual aid funds. The SS-11, at least, probably will be built in quantity for Army use by General Electric Co.

Production Rights

Other European systems for which the government holds production rights through mutual aid participation and which may be built in the U. S. include Fiat's G.91 close-support fighter, which is now being separately evaluated by the Air Force and Army, and Breguet's 1150 Atlantic ASW patrol plane.

The Lear north-seeking gyro, scheduled for use in the Minuteman solid-propellant intercontinental ballistic missile and possibly the Pershing tactical missile system as well, also had its origin in Europe.

Originally conceived by a German scientist as an accurate underground survey instrument, the north-seeking gyro patents were purchased outright by Lear, Inc., from its inventor. Before being placed in production, the unit was further developed and refined by Lear GmbH. and by Lear, Inc., facilities in the United States.

On the two-way street that now exists, Lear is selling the finished product in both the United States and Germany.

(This is the second in a series of articles dealing with U.S. investments and license agreements within Europe and the increasing competition from European firms. Subsequent articles will deal more fully with U. S. subsidiaries abroad, their effect on the "dollar flow," and the move of European industry into U.S. markets and elsewhere.)

Convair Establishes Life Sciences Group

Convair has established a Life Sciences Group, under Dr. R. C. Armstrong, for research on the problems of life in an aerospace environment. The group, located with Convair-Astronautics, has three major divisions: Aerospace Medicine, Human Factors Engineering and Life Support Engineering.

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LETTERS

Polaris Success

Your laudatory and, as usual, penetrating editorial on the Polaris system (AW Apr. 10, p. 21) was most interesting though I personally feel you missed one of the salient points of the success of this program. The primary reason Polaris succeeded, in my view, is because the people in charge recognized, as the Chinese and Congreve did before them, that there is nothing more reliable for making a rocket go than a little bit of gun powder. Just because the Russians, via the Germans, were in pursuit of liquid-propelled rockets was no reason to think that this was the best solution to the problem, or even a practical one.

The Polaris program's success is representative of continued technological progress and was not dependent on any great and radical innovation. The relative cheapness of the program compared to other ballistic missile programs is a clear indication of this.

The liquid rocket has its uses and that is, of course, in the field of high-lift boosters for space exploration experiments where fine control and efficiency are needed and where they can receive the coddling so necessary to their success.

LINCOLN A. WATKINS
Applied Physics Laboratory
The Johns Hopkins University
Silver Spring, Md.

Anti-ICBM Concept

Reference is made to the quotation of Defense Secretary McNamara on p. 28 of the Apr. 10 issue of your magazine. Relative to his decision to deny pre-production funds for certain Nike Zeus anti-ICBM components at this time, Mr. McNamara has reportedly acknowledged that the Nike Zeus system is itself vulnerable to ballistic missile attack.

This seems to constitute a clear admission that the whole anti-ICBM concept embodied in Nike Zeus is probably ill-conceived and doomed to failure. If this is so (and I am personally convinced that it is), how can anyone seriously advocate further extensive expenditures for the program? The fact that $1.75 billion may already have been spent is completely irrelevant to any decision at this time to continue or abandon the project. I hope all the decision-makers appreciate this irrelevance.

Even if Nike Zeus were effective as an anti-ICBM system, it would be a redundant weapon. The United States is clearly counting on Polaris, Minuteman and other weapons with retaliation attack capabilities to discourage any enemy from launching an ICBM at this country. Rather than assuming such discouragement might not be complete (Nike Zeus obviously makes this assumption), we should devote more effort, if necessary, to Polaris and Minuteman to ensure that it indeed will be complete.

R. W. BOESEL
Asst. Project Control Mgr., Polaris
Lockheed Aircraft Corp.
Missiles and Space Division
Sunnyvale, Cailf.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

ANP Program

Why Not an Atom Powered Plane?

The above words were the title to an article appearing in Aero Digest, April, 1954. The article states that an Aero Digest survey shows industry willing and able—but blocked by federal apathy.

If the alleged Pentagon planners even five years ago would have settled for a test-bed airplane at the start, it is entirely possible that our present fleet of B-52s would be nuclear powered.

General Electric claims in a recent issue of AVIATION WEEK (Apr. 3, p. 92) that they have successfully operated modified J47 turobjets for hundreds of hours on nuclear power.

The mating of General Electric's direct cycle engine to the B-52 plus the Skybolt missile would create a weapon system of infinite range and destructive power. It would extend the useful life of the B-52s for many more years and would give some reason for the expenditure of engineering talent and taxpayers' money that have been poured into this project.

While the apparent indifference to nuclear-powered aircraft started during the Truman Administration and was continued during Eisenhower's, I find it hard to believe that our present Administration would arbitrarily cancel this project at a time when success appears certain.

EVERETT PARRISH
Wichita, Kan.

Arms Regression

Now that ICBMs are a reality and mutual annihilation a potentiality, there is a growing tendency in the USAF to return to intercontinental bombers. This regressive action is an expression of uncertainty about the concept of nuclear massive retaliation and its ability to deter. However, the regression is only partial regression, since the type of intercontinental bomber requested by USAF is just another weapon system for nuclear massive retaliation. This nostalgic tendency of USAF (the good old B-36 and A bomb era) is commensurate to the Navy's battleship regression of a bygone era.

An example of the type of antiquity that obstructs modern military planning is the multi-billion dollar B-70 program. Last summer the B-70 enthusiasts propagated the concept that $10 billion spent on the B-70 would force the USSR to spend $40 billion on a defense system against the B-70 bomber. The proponents of the B-70 program capitalized on the publicity of the successful U-2 overflights and got the B-70 reinstated. They conveyed the impression that the Russians would have to spend the $40 billion on a ground-based defense system using surface-to-air missiles and long-range interceptors with air-to-air missiles. However, the Russians with their extensive space program are undoubtedly planning to spend the $40 billion on orbital interceptors which can either intercept or bombard.

The nation and the budget bureau must realize that if the USSR maintains its lead over the U.S. in space research, the Russians may launch orbital interceptors in five or six years. The orbital interceptor (or orbital bomber) would engage in constant surveillance of ICBM installations, missile cruisers, aircraft carriers, and intercontinental bombers.

Only the submarine could escape its surveillance, but even the Polaris missile could be intercepted during its powered phase above the cloud layer.

A most significant achievement of communism when Russian scientists and engineers develop orbital interceptors would be the ability to shoot down the free world's space probes during the powered phase above the cloud layer. This would give the Communist world complete space supremacy.

Such an act of space piracy would tend to defrost the cold war but not to the extent of nuclear massive retaliation and mutual annihilation.

LEROY F. IVERSON
Denver, Colo.

Manpower Plan

The latest spectacular man-in-space achievement of the Soviet Union has once again brought to mind the problem of how this great nation of ours can utilize its full capacity in the production of scientific and space achievements.

Perhaps I can be enlightened by you as to whether this approach to the problem is now in effect or whether it is practical in the true sense of the word.

The program would be as follows: The United States would notify the engineering and scientific world of forthcoming scientific projects; the scope, ultimate goals, fields of specialization required, and research and development to be undertaken for the successful completion of such projects. The United States would then encourage firms throughout the country to donate their key personnel for these projects. These people would remain in the employ of their present employers.

Their salary would still be paid by their employers. This would reduce the fear of losing key personnel by the firms involved. The government would supply traveling expenses, housing or per diem pay to these people.

The tax structure could be revamped to compensate companies for the use of their people.

I feel that this would unite Americans in the struggle against communism.

ALEXANDER PADILLA
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